NORTH ATLANTIC TREATY ORGANISATION

RESEARCH AND TECHNOLOGY ORGANISATION

AC/323(SAS-044)TP/46

www.rta.nato.int

RTO TECHNICAL REPORT **TR-SAS-044**

Decision Support to Combined Joint Task Force and Component Commanders

(L'aide à la prise de décisions pour les commandants de composantes et de groupes de forces interarmées multinationales)

Report prepared by the RTO Studies,

Analysis and Simulation Panel (SAS).

Published December 2004

NORTH ATLANTIC TREATY ORGANISATION

RESEARCH AND TECHNOLOGY ORGANISATION

AC/323(SAS-044)TP/46

www.rta.nato.int

RTO TECHNICAL REPORT **TR-SAS-044**

Decision Support to Combined Joint Task Force and Component Commanders

(L'aide à la prise de décisions pour les commandants de composantes et de groupes de forces interarmées multinationales)

Report prepared by the RTO Studies,

Analysis and Simulation Panel (SAS).

The Research and Technology Organisation (RTO) of NATO

RTO is the single focus in NATO for Defence Research and Technology activities. Its mission is to conduct and promote co-operative research and information exchange. The objective is to support the development and effective use of national defence research and technology and to meet the military needs of the Alliance, to maintain a technological lead, and to provide advice to NATO and national decision makers. The RTO performs its mission with the support of an extensive network of national experts. It also ensures effective co-ordination with other NATO bodies involved in R&T activities.

RTO reports both to the Military Committee of NATO and to the Conference of National Armament Directors. It comprises a Research and Technology Board (RTB) as the highest level of national representation and the Research and Technology Agency (RTA), a dedicated staff with its headquarters in Neuilly, near Paris, France. In order to facilitate contacts with the military users and other NATO activities, a small part of the RTA staff is located in NATO Headquarters in Brussels. The Brussels staff also co-ordinates RTO's co-operation with nations in Middle and Eastern Europe, to which RTO attaches particular importance especially as working together in the field of research is one of the more promising areas of co-operation.

The total spectrum of R&T activities is covered by the following 7 bodies:

- AVT Applied Vehicle Technology Panel
- HFM Human Factors and Medicine Panel
- IST Information Systems Technology Panel
- NMSG NATO Modelling and Simulation Group
- SAS Studies, Analysis and Simulation Panel
- SCI Systems Concepts and Integration Panel
- SET Sensors and Electronics Technology Panel

These bodies are made up of national representatives as well as generally recognised 'world class' scientists. They also provide a communication link to military users and other NATO bodies. RTO's scientific and technological work is carried out by Technical Teams, created for specific activities and with a specific duration. Such Technical Teams can organise workshops, symposia, field trials, lecture series and training courses. An important function of these Technical Teams is to ensure the continuity of the expert networks.

RTO builds upon earlier co-operation in defence research and technology as set-up under the Advisory Group for Aerospace Research and Development (AGARD) and the Defence Research Group (DRG). AGARD and the DRG share common roots in that they were both established at the initiative of Dr Theodore von Kármán, a leading aerospace scientist, who early on recognised the importance of scientific support for the Allied Armed Forces. RTO is capitalising on these common roots in order to provide the Alliance and the NATO nations with a strong scientific and technological basis that will guarantee a solid base for the future.

Published December 2004

ISBN 92-837-1131-9

Decision Support to Combined Joint Task Force and Component Commanders

(RTO-TR-SAS-044)

Executive Summary

The aim of NATO Technical Team SAS-044 'Decision Support to Combined Joint Task Force and Component Commanders' has been to promote an alliance approach to decision support to Commanders. It has sought to establish the current status of analysis in direct support of Commanders within NATO, and Nations, and has concentrated on the general principles for successful analytical support, rather than identification of specific tools and models.

NATO Operational Headquarters have become involved in running operations and have drawn on Operational Analysis (OA) in support. Experience has shown that OA is an integral part of the HQ decision-making process – bringing quantitative analysis with a clear audit trail to inform the decision. OA does not just answer the question posed, but seeks to identify 'hidden' concerns, branches and sequels.

In the Balkans (Bosnia and Kosovo) analysts have been deployed through HQ Allied Command Europe Rapid Reaction Corps (ARRC), NATO Consultation, Command and Control Agency (NC3A), RHQ AFSOUTH, and through nationally deployed OA teams. Recently, 2004, NATO analysts have deployed to support ISAF in Afghanistan. These experiences offer the ideal opportunity to create a Code of Best Practice (COBP), which incorporates these NATO and national experiences and place on record the lessons identified and learnt.

The guidance in this Code is intended to assist analysts and military staff in understanding the principles of providing decision support to Commanders. It is not intended to be prescriptive, nor exhaustive, and is based upon knowledge from experience gained on recent operations. This Code contains pertinent information aimed at helping prepare, deploy, integrate and support OA teams in the field. In addition to the COBP, the team has developed a short summary document (two pages in length), explaining the role of operational analysis in a form more relevant to those working under short time scales, such as senior military commanders. This summary document may be found in the annexes of this code.

Chapter One presents an introduction to, and defines the characteristics of front line operational analysis. This chapter also explains why it is timely to produce a NATO COBP for decision support.

The use of operational analysis to support decision-making is expanded upon in Chapter Two. This chapter looks at where operational analysis can support the decision-making processes within a headquarters, and where an operational analysis cell should be placed in the command chain. Finally, this chapter discusses the position of decision support within the new NATO command structure.

Chapter Three discusses the operational analysts themselves, from the selection of personnel and team leaders to the provision of reach-back analysis.

A number of the issues to be considered prior to, and during a deployment of operational analysts are considered in Chapter Four. Examples of issues raised in this topic include: medical fitness, training requirements, and clothing and equipment.

Many of the decision support tools, techniques and data used by the analyst are presented in Chapter Five. This chapter also makes recommendations relating to a software suite for the provision of operation analysis support to a military operation. The main issues relating to data requirements, information management and data collection within the context of decision support are also included in this chapter.

Finally Chapter Six comprises recent decision support experiences and Lessons Learnt from nations and NATO. It includes specific examples of operational analysis used in decision support in operational situations. The chapter aims to provide guidance to analysts and military staff as to the nature of tasks that operational analysis can address in the support of military command decision-making.

L'aide à la prise de décisions pour les commandants de composantes et de groupes de forces interarmées multinationales

(RTO-TR-SAS-044)

Synthèse

Le groupe technique SAS 044 de l'OTAN sur "L'aide à la prise de décisions pour les commandants de composantes et de groupes de forces interarmées multinationales" avait pour objectif de promouvoir une approche de l'aide à la prise de décisions pour les commandants à l'échelle de l'Alliance. Ce groupe a voulu définir l'état actuel de l'analyse pour le soutien direct des commandants au sein de l'OTAN et de ses pays membres, en concentrant ses efforts sur les principes généraux du soutien analytique efficace, plutôt que sur l'identification d'outils et de modèles spécifiques.

Les quartiers généraux opérationnels de l'OTAN sont désormais associés à la conduite des opérations et font appel à l'analyse opérationnelle (OA) pour le soutien de leurs activités. L'expérience montre que l'OA fait partie intégrante du processus de prise de décisions – l'analyse quantitative, avec sa piste de vérification transparente, apporte les renseignements nécessaires à la prise de décisions. Non seulement l'OA fournit-elle la réponse à la question posée, elle cherche à identifier les problèmes « occultés », les pistes associées et les suites à donner.

Dans les Balkans (en Bosnie et au Kosovo), des analystes ont été déployés par l'intermédiaire du Corps de réaction rapide du CAE (ARRC), par l'Agence des C3 de l'OTAN (NC3A), par le RHQ AFSOUTH, ainsi que par l'intermédiaire de groupes OA nationaux. Récemment, en 2004, les analystes de l'OTAN étaient déployés en soutien de l'ISAF en Afghanistan. Ces expériences ont fourni l'occasion idéale de créer un Code des meilleures pratiques (COBP), incorporant les expériences nationales et OTAN et permettant de consigner les enseignements tirés dans ce domaine.

Les directives contenues dans ce Code devraient permettre aux analystes et aux personnels militaires de mieux comprendre le principe de l'aide à la prise de décisions destinée aux commandants militaires. Le Code n'est censé être ni normatif, ni complet; il est basé sur des connaissances acquises lors d'opérations récentes. Il contient des informations pertinentes destinées à la préparation, au déploiement, à l'intégration et au soutien des équipes OA sur le terrain. Outre le COBP, le groupe a rédigé une synthèse de deux pages présentant le rôle de l'analyse opérationnelle sous une forme plus acceptable à ceux dont le travail est caractérisé par des contraintes de temps, tels que les hauts commandants militaires. Ce document sommaire est inclus dans les annexes de ce code.

Le chapitre 1 propose une introduction, avec définitions, des caractéristiques de l'analyse opérationnelle de la zone avant. L'opportunité d'un COBP OTAN pour le soutien de la prise de décisions est également exposée.

Le chapitre 2 développe plus avant le sujet de l'analyse opérationnelle en soutien de la prise de décisions. Ce chapitre examine les applications possibles de l'analyse opérationnelle en tant qu'aide à la prise de décisions au sein d'un quartier général, ainsi que la place d'une cellule d'analyse opérationnelle dans une chaîne de commandement. Enfin, ce chapitre traite de l'importance accordée au soutien de la prise de décisions au sein de la nouvelle structure de commandement de l'OTAN.

Le chapitre 3 aborde la question des analystes opérationnels eux-mêmes, de la sélection du personnel et des chefs d'équipe à la mise à disposition d'analyses d'opérations.

Le chapitre 4 a pour objet un certain nombre de questions qui seraient à examiner avant et pendant le déploiement d'analystes opérationnels. Ces questions comprennent : l'aptitude physique et mentale, les exigences en matière d'entraînement, l'habillement et le matériel.

Bon nombre des outils d'aide à la prise de décisions, des techniques et des données mises en œuvre par l'analyste sont présentés au chapitre 5. Ce chapitre contient également des recommandations concernant un progiciel d'analyse opérationnelle pour le soutien d'opérations militaires. Les principales questions concernant les besoins en matière de données, la gestion de l'information et la collecte des données dans le contexte de l'aide à la prise de décisions sont également examinées dans ce chapitre.

Enfin, le Chapitre 6 présente l'expérience récente, ainsi que les enseignements tirés d'opérations d'aide à la prise de décisions réalisées par les pays membres de l'OTAN. Il comprend des exemples spécifiques de la mise en œuvre de l'aide à la prise de décisions dans des situations opérationnelles. Ce chapitre fournit des directives aux analystes ainsi qu'aux personnels militaires concernant la nature des tâches de l'analyse opérationnelle dans l'aide à la prise de décisions militaires.

Table of Contents

List of Figures and Tables

Chapter 1 – INTRODUCTION

1.1 AIM OF SAS-044

The NATO Technical Team SAS-044 'Decision Support to Combined Joint Task Force (CJTF) and Component Commanders' was set up to promote an alliance approach to decision support to Commanders. It summarises the general principles for successful analytical support to Commanders, rather than identifying specific tools and models. The Code of Best Practice summarises the current experiences of analysis within NATO and nations.

1.2 COMPOSITION OF SAS-044

The NATO Technical Team SAS-044 'Decision Support to Combined Joint Task Force (CJTF) and Component Commanders' has been fortunate enough to receive support from the following Nations and Headquarters.

Table 1.1: Nations and Headquarters Represented in SAS-044

Nations	Headquarters
United Kingdom	NATO Consultation, Command and Control Agency (NC3A)
United States of America	SHAPE
Germany	RHQ AFNORTH
Norway	RHQ AFSOUTH
France	HQ EASTLANT
The Netherlands	EUCOM
Turkey	USAREUR
Sweden	WPC
Australia (correspondence member)	
Canada (correspondence member)	

1.3 WHY NATO INVOLVEMENT

NATO operational Headquarters (HQ) have become involved in running operations and have drawn on Operational Analysis (OA)[1] in support. For example, in the Balkans (Bosnia and Kosovo), analysts have been deployed through HQ Allied Command Europe Rapid Reaction Corps (ARRC), NATO Consultation, Command and Control Agency (NC3A), RHQ AFSOUTH, and through nationally deployed OA teams. This experience offers an ideal opportunity to create a Code of Best Practice (COBP) which incorporates these experiences and places on record the lessons identified and learnt.

[1] For the purposes of this paper 'Operational Analysis' (OA) = 'Operational Research' (OR).

1.4 WHY HAVE A COBP

OA uses scientific methods and quantitative rationale to improve situational awareness, to facilitate decision-making and to improve the quality and effectiveness of operational planning and execution. Within a HQ, there is a requirement for a pro-active, co-ordinated OA input into the decision processes of functional areas such as operations, logistics, planning and Civil-Military Co-operation (CIMIC).

The guidance in this Code is intended to assist analysts and military staff in understanding the principles of providing decision support to Commanders. It is not intended to be prescriptive, nor exhaustive, and is based upon knowledge from experience gained on recent operations. This Code contains pertinent information aimed at helping prepare, deploy, integrate and support OA teams in the field.

In addition to the COBP, the team has developed a short summary document (two pages in length) explaining the role of operational analysis in a form more accessible to those working under short time scales, such as senior military commanders. This summary document may be found in Annex A of this COBP.

A COBP is a living document and, as such, should be reviewed periodically. Timely reviews will: ensure that changes which affect either the provision or quality of support are incorporated as quickly as possible; minimise the risk of inadequate support being provided; and make certain that the document remains a pertinent source of information for both analysts and commanders.

1.5 DEFINITIONS

For the purposes of this Code of Best Practice (COBP), the following definitions have been assumed:

- Operational Analysis (OA) is the ‘application of scientific methods to assist executive decision-makers’.
- Decision Support is the ‘application of the best available analytical tools and/or techniques to support the decision process’.

1.6 BACKGROUND

The origin of operational analysis lies in the run-up to World War 2 (WW2). Operational research carried out by civilian scientists and analysts lead to the efficient deployment of new radar technology to form an integrated UK air defence system. Another well-known WW2 example of the application of OA is the advice given to commanders in Anti-Submarine Warfare (ASW) in order to counter the German U-Boat threat. Following WW2, the UK continued to use OA to support commanders in the field, for example an OA cell deployed to Singapore during the Communist Insurgency in Malaysia. In addition, the US army made considerable use of front line OA during Vietnam operations. Further examples of OA support to commanders were demonstrated by UK and US analysts in support of operations to liberate Kuwait (1991). The end of the Cold War brought about an increase in the use of OA in Crisis Response Operations. NATO and nations introduced analysis capabilities within HQs to support decision-making in this complex environment. More recent developments in the Global War On Terror (GWOT) and Effects Based Operations exhibit support provided to a wide range of missions including Afghanistan and Iraq.

1.7 CHARACTERISTICS OF DIRECT OA SUPPORT

OA may be used in both “deliberate planning” and “crisis action planning”. Deliberate planning occurs during peacetime and takes place over a period of months. Deliberative planning is collaborative, based substantially on assumptions, and allows long lead-time analytical work to influence key decisions. Crisis

action planning is done during crises, and deals with the real situation, enemy and available forces, and is heavily time constrained. The OA support provided in both of these situations will have the following characteristics:

- **Independent –** Refers to the unbiased nature of the Operational Analysts' support – the Operational Analyst typically does not have a vested interest in any one of the unique functional-area perspectives of the members of the Joint staff.
- **Credible –** Refers to the support being defendable. The Operational Analysts' role is to bring logic and structure to the often otherwise highly subjective nature to the decision-making process.
- **Understandable –** Refers to the Operational Analyst's ability to communicate with the operators and decision-makers. The Operational Analyst reduces the dizzying array of information into the essential nuggets that inform the decision process and provide that knowledge in a format meaningful to the commander and staff.

There are specific characteristics and constraints to the analysis provided in direct support of commanders. For example:

- **Timeliness** – The time scales available for answering problems are usually short, with a primary response window of 2 to 72 hours.
- **Data Se**t – The data used is usually current/near term, often directly using data derived directly from operations, trials and exercises.
- **Problem Owner** – Normally an 'individual' rather than a 'committee/community'.
- **Deployability** – OA capabilities are distributed at various sites and there are likely to be only a small numbers of analysts deployed in the field.
- **Wide Scope of Questions** – Reliance on the wider analytical and scientific community.
- **Resource Constraints –** These tend to be what the commander has available in theatre, rather than financial.
- **Completeness of Answer** – In the time-constrained operational environment, a partial answer is often all that may be possible (a 100% solution too late is worse than an 80% solution on time). In these instances, the limitations and assumptions of the analysis must be clearly identified.
- **Context** – The analysis and the guidance offered must be realistic and relevant to the military context.

Chapter 2 – HOW OA SEEKS TO HELP DECISION-MAKING

2.1 WHAT DOES OA SEEK TO PROVIDE?

OA is an integral part of the HQ decision-making process – bringing quantitative analysis with a clear audit trail to inform the decision. OA does not just answer questions as posed, but seeks to identify "hidden" concerns, branches and sequels. It may well be that the original question is modified as a result of this process. The analyst also needs to identify limitations of analytical efforts, particularly if it will not be possible to fully meet the commander's intent. Finally, it is important to remember that analysts are not deployed to provide Information Technology (IT) support services.

2.2 WHAT TYPE OF ANALYSIS IS REQUIRED BY A HQ?

OA can be used to address a wide range of problems and assist in finding a solution through the structuring, collating and organisation of data. Figure 2.1 shows a generic decision process for a military organisation. OA can provide advice throughout the decision-making process, but makes substantial contributions to the areas highlighted below in Figure 2.1.

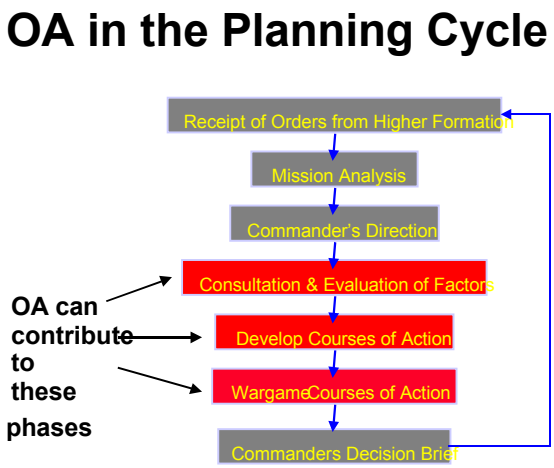

Figure 2.1: The Contribution of OA to the Decision Process.

The breadth of analysis provided to a HQ is clearly shown through the experiences of the RHQ AFNORTH OA Team whilst on CJTF exercises. The OA team at AFNORTH is a mixed team of civilian and military personnel. OA is integrated into both the peacetime and operational HQs, and as such can be used to provide support over the whole CJTF operation: planning, mounting, deployment, execution, redeployment and post-deployment. Examples of user requirements relating to Crisis Response Operations were consolidated over two major CJTF HQ exercises and other operational experiences. The OA team at AFNORTH found that exercising the team over the operation provided valuable experience. Analysis skills and model capabilities were tested against real world problems and operational timelines.

A typical question posed to an analyst will depend upon the situation under consideration. Generally the questions are quantified logical projections, e.g. "what if….?" Historically, the typical OA questions related to assisting in warfighting operations, for example, are course of action analysis and/or logistics planning. However, recent military operations have seen the deployment of military forces in roles such as peacekeeping. This has increased the breadth of questions being asked of the analyst, for example, measures of normality in a society and assessing data from Non-Government Organisations (NGO). In general, examples of the areas in which OA can make substantial contributions are shown in Table 2.1.

Table 2.1: Examples of OA Support which may be provided during an Exercise or Operation

Phase	User Requirement
Planning ("get ready")	Comparison of Courses of Action (COA) (e.g. risk assessment, wargaming).
	Development of an analysis plan as part of an operational plan.
	Success Indicators and Measures of Effectiveness.
	Contingency planning arising from risk assessment.
	Force Assessments for Situation Awareness and Scope Disarmament Requirements (Force Ratio, Equipment Holdings).
	Data collection plan: both for immediate use and long-term analysis.
	Operational planning – logistics, deployment, engineer.
	Information management.
	Liaison with wider analysis and scientific communities.
	Risk analysis.
	OA support to exercises.
	Part of HICON/EXCON – use of OA techniques to ensure realism of exercise.
	Test OA tools/techniques to support HQ decision cycle.
	Evaluate operational options (Wargaming, static map game).
Prepare/Deploy ("go")	Map mounting process and identify critical path, bottle necks, etc.
	Participate in pre-deployment training, brief on OA and share OA experiences.
	Participate in Mission Rehearsal.
Execution ("do")	Track and analyse success indicators and measures of effectiveness.
	Lessons identified: compile (build database), prioritise, categorise (by type and department responsible), disseminate data.
	Support to continued Operational Planning (as per planning phase).
	Develop and support contingency planning.
	Trade-offs: resource/asset-to-task allocation and synchronisation of operation.
	Data collection and analysis.
Post-operations ("review")	Administer and analyse questionnaires.
	Input to After Action Reports and Lessons Identified.
	Assist in the review of CJTF HQ processes.
	Revise Standard Operational Procedures (SOP).
	Assessment of experiences.
	Post-operation reconstruction.
	Review, archive and advertise analysis undertaken.

The collection of data during an operation is of crucial importance to post-operational analysis. Much data are lost, written over or deleted in the course of an operation, owing to storage space limitations and the pressure of lack of time. As such, it is important to make sure that the data collection plan is worked out thoroughly in advance of the operation so as to facilitate post-operation analysis.

The OA team should also summarise and share their experiences, including feedback for a COBP, and if appropriate, revise any extant Standard Operating Procedure (SOP). Assessment should also be made of the suitability of any OA toolkit used, the reintegration of personnel into their normal daily life, and finally, any requirements for the retraining of personnel should be identified.

2.3 OA CELLS IN THE COMMAND CHAIN

It is important that analysts make commanders aware of the range of their capabilities, as not all officers will have had prior exposure to direct analysis support. Analysts need to be proactive, have the ability to produce timely analysis and 'sell' the analysis product. Wherever possible, the tasking process should be explicitly defined and there should be a clear understanding throughout the command chain of how the OA cell carries out its function; or to put it simply – what it is, how it is done and what it is not.

There are a number of different templates as to the location of the OA cell within a HQ. OA can contribute to the planning and decision processes in all parts of the HQ and hence analysts need a degree of freedom to work across the HQ. In general, the OA should be responsible to a single senior individual as high up the command chain as possible. There are good examples of OA cells formally reporting to the Chief of Staff (COS) of an HQ, even if the specific tasks may have originated within branches (logistics, planning, engineers, etc.). OA cells have also successfully functioned from within an individual branch, but the key is that the OA capability is seen as an HQ-wide asset.

It is important that analysts are seen as an integral part of the HQ (even though in many instances they may be civilian); they should be involved with all the activities with the HQ. In the event of the HQ deploying on an operation, the analysts would also deploy. Thus they must be seen as a normal staff branch and should take part in all relevant training and exercises. OA to support HQ decision-making requires as much training and exercising as any other HQ branch function. It is through this day-to-day interaction with HQ staff that the value of OA can be routinely demonstrated and trust built up between the analysts and HQ staff.

2.4 HOW OA SUPPORT IS STRUCTURED

When considering the number of staff to be deployed, and the number required in a reachback role, a RHQ AFNORTH Operational Analysis Workshop [1] notes that "Having critical mass is extremely important and the number to achieve this depends on the HQ and the mission. Lessons identified from operations suggest a minimum of 2 on-site analysts with access to reachback support." Furthermore, lone analysts are not able to 'bounce' ideas between colleagues to ensure that the most appropriate analytical support is provided.

It is preferable to have an OA cell embedded within both peacetime and combat establishments. OA cells have been successfully embedded within a Command Group, under the Chief of Staff, but with direct access to the Assistant Chief of Staff or the J-heads when required. The inclusion of an OA cell in both peacetime and combat environments will allow a good working relationship to be established between the analysts and the military who will work closely together in areas such as exercise evaluations and identifying lessons learned.

2.5 DECISION SUPPORT IN THE NATO COMMAND STRUCTURE

The Prague Summit held in October 2002 saw a paradigm shift for the future of NATO and the way its military organisation should be structured. As of August 2003, the Military Committee agreed the roles, organisation and manpower levels of the new NATO Command Structure (NCS), which will be fully implemented by June 2006. This decision, and the subsequent reorganisation, have serious implications for the provision of analytical and decision support within NATO.

The prime objective of NATO is the provision of collective defence for its members. However, since the end of the Cold War, the main threat has changed from one single, clearly defined source, to something much more distributed and undefined.

In order to cope with this change, NATO reoriented its command arrangements resulting in Northern and Southern Regional Headquarters overseeing a large number of Joint Sub Regional Commands and Combined Air Operations Centres, on behalf of the Strategic Command. This structure was not, however, designed to achieve a clearly defined objective, rather it evolved in an ad-hoc fashion in response to a changing world.

In October 2002, decisions were taken at the Prague Summit to address the future roles and responsibilities of NATO. One of these specifically addressed the streamlining of the existing command arrangements through a Functional Review (FR). As a result, whilst the new NCS is driven by political intent – it could not be otherwise in such an alliance – this intent is clearly defined in the framework of a vision for NATO's future roles and responsibilities.

One of the key objectives for the NCS FR was to achieve the functional alignment of operational HQs with the Combined Joint Task Force (CJTF) concept, based on robustness criteria arising from the member countries level of ambition for NATO. In essence, the Peacetime headquarters of the NCS should form the core of the deployable CJTF and Component Command (CC) HQs. As a result, the peacetime structure of Allied Command Operations (ACO) will reflect the operational structure that it has to support and implement.

One of the results of this restructuring is the creation of Operational Analysis Branches within operational headquarters of ACO. The decision to institutionalise OA into the organisation was based largely on NATO's experience in Bosnia and Herzegovina [2], and the findings of the IFOR and SFOR Data Collection and Analysis study [3]. This study identified, amongst other things, the value that such embedded decision support can bring, and the fact that the effectiveness of such support increases if it is used during peacetime training, as well as deploying with the HQ in times of crisis.

Of the nine Joint Force Command, Joint Command and Component Command headquarters, all but the Maritime Component Command will have an OA Branch (see Table 2.2 for a breakdown of branch manning). These Branches will be located within the HQ Command Groups and will report to the Chief of Staff (COS) directly in an advisory role. In the case of the Maritime Component Command, the single civilian analyst is also located within the Command Group, and reports directly to the Deputy Chief of Staff for Operations (DCOS OPS).

Table 2.2: NCS FR Results – OA Branch Manning in ACO

	Staff Type		
HQ	**Military Analyst**	**Civilian Analyst**	**Total Number of Staff**
JFC			
JFC HQ Brunssum	3	1	4
JFC HQ Naples	3	1	4
JC Lisbon	1	1	2
ACC			
CC-Air Ramstein	3	2	5
CC-Air Izmir	3	2	5
LCC			
CC-Land Heidelberg	1	1	2
CC-Land Madrid	1	1	2
MCC			
CC-Mar Northwood	0	1	1
CC-Mar Naples	0	1	1

The Supreme Headquarters Allied Powers Europe (SHAPE) will not have embedded OA within its organisation, but will rely instead on support from other NATO bodies such as the NATO C3 Agency. At the time of publishing, there are no plans for a central co-ordinating body for OA activities across Allied Command Operations (ACO), however, SACEUR remains responsible for conducting their own operational analysis and technical support for the command structure and for operations [4].

The existence of established OA teams is not a new concept for NATO OA organisations or personnel, as they already exist in: Regional HQs; at some CC-level HQs; and at lower echelons such as ARRC and SFOR HQ. However, this new structure represents a huge increase in capability to provide decision support within the peacetime establishment. In addition, the fact that the civilian analysts are deployable will enable these personnel to fill Crisis Establishment posts and support the HQs in the field.

In summary, when the new NATO Command Structure reaches full operational capability in June 2006, Operational Analysis Branches will be created in seven peacetime headquarters, with a total complement of 26 military and civilian analysts across ACO. These analysts will form the core teams providing OA and decision support to the CJTF and CC HQs when deployed on exercise or operations.

2.6 REFERENCES

[1] RHQ AFNORTH Letter 2030/ANCGOA/01 Summary of Workshop on Operational Analysis 29 October 2001.

[2] Lambert, N.J., The Success of the NATO Operations in Bosnia and Herzegovina 1995-2000. European Journal of Operational Research 140 (2002) pp. 459-481. Available from www.elsevier.com/locate/dsw

[3] RTO TR 6 AC/323(SAS)TP/11 Published March 1999.

[4] North Atlantic Military Committee, Final Decision on MC 324/1 The NATO Military Command Structure, MC324/1 (FINAL) 28 May 2004, NATO RESTRICTED.

Chapter 3 – OPERATIONAL ANALYSTS

3.1 INTRODUCTION

This chapter discusses general issues that should be taken into account when considering the personnel that make up an OA cell. In recent NATO and coalition deployments, cells contained civilian analysts, often with military augmentation – HQ ARRC, NC3A and AFSOUTH in Bosnia and Kosovo, US and UK in Afghanistan and Iraq. Those nations who deployed analysts in their HQs also have different approaches – the UK generally has teams composed of civilian analysts, the US has both civilian and military analysts, and the Netherlands have civilian analysts but provide them a temporary military rank.

The training requirements of the civilian and military members of the OA cell must be carefully considered. It is of vital importance that deployed analysts receive technical training to allow them to carry out their role competently and to the expected standard, and that civilian analysts receive military awareness training. The latter will ensure the analyst is briefed on the structure of the armed forces, the role of their military colleagues and have the requisite field skills.

3.2 SELECTION OF PERSONNEL

The importance of the deployable scientist's personality and overall training becomes apparent when considering team issues. The team needs the professional skills to be effective and the personality to make a positive contribution to team cohesion, effectiveness and safety. Team members need to meet the analysts' values listed below:

Analysts' values	
• Be loyal	• Be helpful
• Be frank yet tactful	• Be a team player
• Be proactive	• Be a smart worker
• Be 100% honest	• Be timely
• Be an expert	

Ideally, all these criteria should be considered when recruiting staff.

3.3 TEAM LEADER

It is essential to have a single team leader, as the military dislike a confused chain of command. The team leader may be civilian or military, for example the UK experience has been with a civilian team leader, whilst the US normally has a military officer as team leader. The team leader should be technically competent and know the primary reachback organisation. The team leader must have the confidence and competence to be able to make decisions both about the work and the team's safety, even when unable to contact the home establishment. They must know the limits of their authority and must be given the confidence that they will be supported after the event provided decisions are taken within that authority. Finally, the leader must have the confidence of the commanders and staffs.

3.4 TEAM COMPOSITION

To make best use of the warning time, staff selection, and as much staff training and exercises as practicable, should be completed in peacetime, as the flexibility for such activities reduces when an operation is about to be launched. Furthermore, conducting training and exercises during peacetime reinforces on the individual the commitment they have made.

Accommodation and working areas are usually very cramped, and a team should be as small as practicable for the expected workload. A template, which has shown to be successful, is a team is comprised of about 4 people capable of working in two elements of 2 and a staff officer. In a multinational HQ, such a team composition will inevitably lead to different Nations being represented within the OA cell. All members of the OA cell must be deployable and may be prepared to work in shifts whilst deployed.

However, it should be noted that mixed teams, where the military members also have analysis experience, could have a different composition to that proposed. The OA team will almost certainly require administrative support. As such, the OA cell may contain up to eight members; that is between two to six analysts, a team leader and a staff officer.

The staff officer should be staff trained and numerate, and hold an appropriate rank (approx. OF 3/4 or Capt/Major). The staff officer should be able to offer advice on military issues and liaise with all involved military organisations and elements when required. The officer may wish to create a permanent network of named Points Of Contact (POC) within the various branched of the HQ. Again, should the military members of the team have analysis experience, a different approach to that proposed could be used.

One member of the team should have a secondary duty as IT lead, responsible for the team's equipment and any IT interface with host HQs. It is worthwhile considering the appointment of one of the analysts as the team's information manager. This manager should be responsible for the staff routines for handling and storing data within the OA cell and for implementing proper data information management.

3.5 TEAM WORKING

It is possible that a HQ may operate twenty-four hours a day. Analytical support must be provided in accordance with this working schedule. Nevertheless, 24-hour manning of the cell is only required when there are specific tasks which must be provided throughout the day and night. It may be possible to provide a reduced manning level for the night shift. When providing 24-hour coverage, it is possible that the analyst working during the night shift may have time to consider some of the longer term/general support analysis tasks. During a planned exercise, if a HQ decides to exercise its ability to work twenty four hours a day, it is important that the OA cell takes this opportunity to also practice working at this level.

As a general rule, manning for 24 hours a day, seven days a week can be maintained for reasonably short periods of time, up to a maximum of about 20 consecutive workdays. Long deployments should plan for one day off for every six consecutive days of work. However, it should be noted that when on deployment, there may be very limited distractions outside of the working environment and long working hours can become routine.

It is necessary to develop a policy to ensure that reserve analysts are trained and prepared to deploy should any individual become unavailable, or return early, due to a variety of personal and/or business reasons. Reserves should be able to mirror all the capabilities of the team. As soon as a reserve is used (or otherwise becomes non-available) then a replacement for the reserve should be found.

3.6 ANALYSIS REACHBACK

Reachback is a process whereby a question or request for data is sent by a deployed analyst to a separate organisation for action that is beyond the means of the deployed analyst. The responding organisation may be in the operational theatre, or more likely home-based. In many instances, the role of reachback is to carry out detailed analysis, input of specialist knowledge, or the application of detailed models. Factors that should be taken into consideration when using reachback are:

- Communication between the deployed analyst and "reachback" analysts and technical experts
- Situational awareness of reachback analysts
- Time difference between theatre and the home-base
- Operational security
- Realisation of time scales to achieve an answer

Reachback is an important feature which extends the capability of the deployed analysts. The commanders and their staff must be aware of this capability, but it must be used via the deployed team of analysts. The use of reachback requires a specific point of contact who may have to be locatable at the home-base for twenty-four hours a day. Depending upon the operational tempo/urgency of the operation, a call out system of subject matter experts may be necessary. The use of reachback is also dependent upon a reliable, and if required, secure line of communication between the deployed analyst and the specified reachback organisation.

During a high tempo operation, analysts working at the home-base in a reachback role are unlikely to be able to maintain a high level of the most up-to-date situational awareness. This will limit the types of analytical tasks which can be usefully carried out at the home-base.

Chapter 4 – OPERATIONAL ANALYSTS ON DEPLOYMENT

4.1 INTRODUCTION

This chapter discusses a number of issues that need to be considered prior to and during a deployment of operational analysts. Civilian personnel are subject to the same risks as military HQ personnel. It should be emphasised that under the Geneva Convention, civilian personnel giving direct support to the military are legitimate targets for enemy action, but civilians who engage in military action are not covered by the same protection as military personnel. The aim of this chapter is to introduce best practices for staff deploying on operations: they are guidelines only and are not intended to be mandatory.

4.2 READINESS

A deploying HQ must have confidence that its OA cell will be available if required. To this end, there should be an agreed readiness state from which the OA team plans are developed, the team is assembled and resources are apportioned.

Readiness time is the time within which a unit can be made ready to perform the tasks for which it has been organised, equipped and trained. It does not include transit time. During this period, the scientific staff deploying should be assisting the planning at the deploying HQ, handing over existing tasks to alternative staff and preparing themselves professionally and personally. Readiness requirements for OA teams will be dependent upon the operational status and mission of the HQ. For example, OA staffs within HQ ARRC are generally at 15 days notice to move.

Figure 4.1: A Deployed OA Team.

4.3 MEDICAL FITNESS OF PERSONNEL

Individuals need to be fit and sufficiently healthy to cope with the rigours of an operational environment. Annex B.1 suggests levels of personal fitness, inoculations and medications required by deploying analysts.

4.4 TRAINING OF PERSONNEL

Operational Analysts provide support to many aspects of the NATO armed forces, and consequently, civilian staff may be required to deploy to operational HQs in theatre or on exercises. The legal requirements and appropriate duty of care for individuals depends upon their nationality and employment status; this is an issue of which the team leader will have to be aware. To fulfil this requirement, only suitable and appropriately trained staff should deploy to an operational theatre. The needs of an analyst at a high state of readiness must be recognised by the individual's parent organisation, which must provide the necessary resources to meet the obligations.

It is highly recommended that any organisation deploying civilian staff to an operational theatre should assign a deployments officer who is responsible for advising on and ensuring compliance with the necessary preparations. All preparation and training should be realistic and be based on the worst-case scenario rather than the most likely or optimistic situation.

The practices outlined in this section are generic guidelines for all operations and all departments. However, common sense should be applied. The preparation may be different for short deployments, particularly those to rear or benign areas. An appropriate medical should always be mandatory, as should the arrangements for welfare support and the keeping of proper records. The following training requirements should be considered.

4.4.1 Mandatory Training Requirement

- Nuclear Biological and Chemical (NBC)
- Mine awareness
- Law of Armed Conflict
- Counter-terrorism
- Battlefield first aid

Weapon awareness training is also highly recommended. Whenever omitting any pre-deployment preparation, consideration must be given to the impact on dependants or the media reporting of the failure to take reasonable precautions.

It is essential that appropriate levels of security clearance are obtained and remain current throughout the deployment.

4.4.2 Strongly Recommended Training Requirements

The essential scientific skills required for each deployment should be identified and a training plan should be put in place. The analyst should have a basic level of military awareness, including how to interact with the military and the basic rank structure of the armed forces. The training provided must allow the analyst to assist in the build up to, during and after any deployment. Depending on the role and location of the deployment, the following training is recommended:

- Field skills: living in the field, field hygiene, shelter erection, correct wearing of combat clothing and packing for the field, navigation, use of radio, etc.
- Manual handling
- Health & Safety (including the applicability of national regulations in effect)
- Sea safety and/or Helicopter Dunking

It is possible to design a course covering all of the above skills, and course attendance should be considered as part of the selection criteria for deployable staff. Staff with previous military experience may be exempt from the entire course, but their general suitability should be assessed.

4.4.3 Pre-Deployment Training Requirements

Before deploying, the analyst should have a high level of technical awareness, often gained from the analyst's scientific background. However the analyst should also have:

- An understanding of the background to the crisis (pre-deployment briefings)
- A knowledge of the analysis models being taken on deployment
- Approximate data estimation techniques (orders of magnitude and dimensional analysis)
- An awareness of previous lessons identified from deployment

Analysts should train whenever possible on Exercises to familiarise themselves with the life and work of a HQ. This may allow the analyst to experience uncomfortable, harsh working and living environments, which will allow the analyst to develop their own personal "survival kit" (personal items for use and the correct mental attitude).

It is important that the analysts who are to be deployed understand the nature of the operation. Ideally, they should be involved in the planning itself (at the level appropriate to their work whilst deployed) to build up an understanding of the Commander's Intent, the Concept of Operations, the Operational Objectives and the End State.

There are also other opportunities for the analyst to build up ties with the deploying HQ. There is likely to be collective training by the HQ, the basic elements of which will include:

- Information on the mission
- Threat Assessment
- Geography specifics
- Cultural
- Team building
- Mission rehearsal

4.5 PRE-DEPLOYMENT RISK ASSESSMENT AND DOCUMENTATION

4.5.1 Risk Assessment

Many organisations will use some form of risk assessment prior to the deployment of civilians to support a military operation. In addition, the risk assessment conducted during peacetime is very important. Assessments are a major tool to identify gaps in the selection, training and other procedures. A risk assessment should be carried out annually during peacetime, and be re-issued prior to each deployment. When conducting the risk assessment, emphasis should be placed on those risks that can be mitigated by training or appropriate personnel selection. The risk assessment should be in synchronisation with the military risk assessment. Some of the main risks to consider include:

- Environmental risks: heat and dust, cold and wet, natural diseases, poor hygiene and toxic contamination.
- Poor health and safety: misuse of firearms, poor lighting, dangerous obstacles, vehicles and machinery, unreliable transport, lifting injuries and tired and stressed personnel.
- Hostile acts, direct and indirect fire, air attack, NBC, land mines and friendly fire.

4.5.2 Documentation and Mobilisation

In the event of a crisis, staff should be given adequate warning and long lead items should be started as soon as possible. In particular, the risk assessment should be started, medical records updated and any further inoculations required should be provided. Whilst some inoculations may be dependent upon national policy, the analyst should be aware of any specific requirements for the geographic location of the deployment. It should be noted that malaria tablets may need to be taken at least 7 days in advance of departure; other inoculations may not become effective for several weeks after they are given (six months for anthrax). It is unlikely that significant training can be provided in the period before deploying (except possibly in the case of a planned roulement). Instead, emphasis should be placed on refresher items such as NBC and mine awareness. It is good practice to produce a checklist of preparations in order to ensure that all the relevant procedures are documentation and completed. An example checklist is given in Annex B.2.

4.6 CLOTHING AND EQUIPMENT

The decision to wear military (combat) or civilian clothing is dependent upon a number of factors including the military or civilian status of the analyst, NATO and national policies, the work of the scientific team, and where in the field they will be operating. If military clothing or equipment is required by a nation or body for civilian analysts, then it must be provided by that nation or body.

The arguments for and against civilians wearing military clothing are:

- Civilians wearing military clothing could be at greater risk because they look like the military.
- Civilians wearing civilian clothing in a predominately military environment will stand out and may be confused with VIPs or interpreters, and as such, may be the target of choice for snipers and terrorists. This risk was seen as sufficient for SFOR interpreters to be issued UK uniforms in Bosnia.

In practice, analytical staff have found it much easier to be accepted into a HQ, gain access to sensitive information, and to administer themselves if they are wearing military clothing. However, if military clothing is worn, then it must be worn according to national dress codes. Kit lists for military clothing and equipment are included in Annex B.3. Irrespective of whether the analyst wears uniform or civilian clothes, it is essential that they carry appropriate identification, both national (Member of Ministry/ Department of Defence/Defense) and international (NATO, Geneva Convention card – stating the right to be treated as a prisoner of war).

The ultimate decision on the choice of dress must remain with the commander of the headquarters, who must balance the operational risks with the responsibility for providing a secure environment for all personnel.

One possible additional reason for the use of military clothing is that analysts may be required to wear NBC protective gear. NBC suits are designed to be worn over military clothing – should the suit be worn over civilian clothes, they are likely to be ruined. When considering NBC protective gear, it should be remembered that respirators need to be fitted to a specific individual and may require corrective lenses. The lead time for lenses, and the requirement for training, mean that it is necessary to issue and fit respirators in peacetime.

Field equipment includes all of the non-clothing items that will allow an individual to operate with reasonable comfort in austere conditions. As a minimum, this must include a sleeping bag and a rucksack. However some deployments require the full paraphernalia of living in the field, e.g. webbing, mess tins, water bottles, etc. If the individual deploys in military clothing, then the field kit should all be military issue from the analyst's home nation or deploying body.

The OA cell may, depending upon the deployment and their own National legislation, require their own form of transport, e.g. hire car. Any analyst being deployed should also consult their own Nation's legislation on the carrying of weapons for self defence.

4.7 COMPUTER EQUIPMENT

The HQ will have its own IT, however in addition to this, it is preferable for the OA cell to have its own IT assets. This is essential to allow the OA team to run tools and models that are not accredited for use on the HQ command systems. Determination of the IT requirements should be the responsibility of an IT manager appointed by the OA team leader. This could be a set of laptops, operated either stand-alone or with the equipment to configure a small LAN, plus printing facilities.

The OA team needs to communicate its results to the military staff. To this end, it is essential that the OA team IT and communication requirements (e.g. secure, insecure, voice, fax, e-mail (including reachback requirements)) are made known, particularly to the Computer Information System (CIS) staff within the HQ, well in advance of deployment. It should also be confirmed that the IT assets taken are compatible with those of the HQ.

When using both HQ and the OA cell IT assets, the experience of analysts working at AFNORTH and HQ ARRC suggests that the best combination is the use of HQ CIS to communicate and promulgate OA advice and the OA team's own IT assets to carry out the analysis and run any OA tools or models.

The means of deployment of the equipment is an issue that the IT manager will need to address. The aim should be for a deployed analyst to arrive at their place of work with sufficient capabilities to enable them to offer immediate, at least partial support to the military customer. A sensible option is the preparation of laptops loaded with all likely tools, models and data to support the envisaged operations.

Implicit is the assumption that the OA team will have access to a laptop computer of sufficient capability to execute the necessary software. Consideration should also be given to different means of transferring and backing up data (i.e. USB pen drive, floppy disks, CD writer, PC link cables, network capability) and whether or not print capability will be required. All equipment – personal, IT or team – should be clearly marked and double-wrapped for protection from damp and dust. A suggested IT and associated consumables list for deployments is presented at Annex B.4. It is also recommended that, whenever possible, some spare equipment (e.g. one extra laptop or an extra hard drive) should be included. In some environments, considerations should be made for using "rugged-ized" equipment and PDA-sized devices (which are especially useful for data collection). A digital camera is also an invaluable tool on such deployments, especially as an aid to data collection.

There is also a training implication. The operational analyst must be expert in at least the critical tools, and ideally would have a working knowledge of the additional tools listed in Annex C.

4.8 LEAVING THEATRE

Upon leaving theatre, a 'handover' of responsibility to a new set of analysts may be required. This can be best achieved through an overlap of the departing/arriving analysts within theatre. This allows the analysts who will be taking over the cell to gain an in-depth understanding of the data recorded, and the methods/techniques used to provide analytical support. During the handover, the arriving analysts should have an awareness of the support provided by previous analysts to specialist cells.

The departing analysts should archive all data and results that may be returned to the home-base. Whenever possible, it should be ensured that these data and findings are duplicated and returned to home-base by different routes/means in order to guard against accidental loss or damage.

4.9 ACTIONS ON RETURN TO HOME-BASE

Organisations should maintain a record of all deployments, including an individual's date of arrival in theatre, date of departure and primary location. This record should include any incidents that may have long-term implications or a delayed effect, any medication taken, accidents, exposure to disease, NBC weapons or any injury. This record is essential if follow up treatment is required. If there is any concern, then a post-deployment medical or post-traumatic stress counselling might be appropriate. It may be advisable to hold a post-deployment medical as a matter of routine, in order to establish the medical condition of staff on return home from theatre.

Chapter 5 – DECISION SUPPORT: TOOLS, TECHNIQUES AND DATA

5.1 INTRODUCTION

This chapter presents possible tools and techniques for decision support and also discusses many of the numerous issues associated with data.

The objective of this chapter is two-fold. Firstly, an overview of current OA tools and techniques is presented and recommendations are made relating to a software suite for immediate OA support to a military operation. Secondly, the main issues associated with the data requirements, information management and data collection are considered within the context of decision support.

5.2 DEFINITIONS AND EXAMPLES

For the present context, a *technique* is defined as a general description of the analyst's approach to solving a problem – the way he/she works to carry out the tasks at hand. Examples of common OA techniques are simulation, statistical analysis and spreadsheet modelling.

To apply a specific technique, the analyst may need to use a variety of *tools* – devices used to carry out particular functions – to collect and analyse available data, and to present the necessary information to the decision-makers. Some examples are spreadsheets, statistics package and simulation software, as well as more traditional tools such as reference text books, doctrine, equipment manuals and paper maps.

These broad definitions should not be taken too literally. It is often difficult to draw sharp borders between the two terms.

Embedded in the analyst's efforts is the need to collect, synthesize and analyse data. Proper handling of data (retrieved and produced) is critical. This *information management* includes cataloguing for future reference and correlating related information.

5.3 DECISION SUPPORT TOOLS AND TECHNIQUES

A general list of possible tools and techniques, in alphabetical order, with possible uses in theatre, is presented in Annex C. For those who wish greater detail on specific analysis techniques, or wider treaties on analysis, may wish to consult the extensive Bibliography in Chapter 9 of this report.

5.3.1 General Comments on Tools and Techniques

OA can be used to support the military in a wide variety of areas including in barracks, whilst on exercise, and on operations (as shown in Chapter 2 of the COBP). The types of OA tasks required to support a military operation changes over the life of the mission and will vary with the operational environment and customer demands. Different tools/techniques will be used depending on the command level involved, phase of the operation, and the intensity of the conflict.

The important thing for the analyst is to be problem centric at all times, not tool centric. The problem is the issue, and it is more important to provide timely answers than to perform detailed analysis with academically preferred tools.

Analysis support at the strategic, operational and tactical level will differ in appearance and detail. Tools and techniques used at the strategic level will often be less specific than those used at the tactical

level. At the tactical level, tools must be able to cope with specific details of systems commanded and controlled at this level, e.g. weapons, communications. At the strategic level, the aggregation of data of different types and from different sources becomes important, and this creates its own challenges. Tools and techniques at this level should be able to deal with different types of data, collected in varying ways, and be flexible.

The changing nature of the operation also influences the type of tools and techniques that will be of use. There are several phases within an operation: planning/preparation, deployment, execution, recovery and post-operation work. A wide range of tools and techniques are useful in the planning phase and much of the decision-making is done here. During execution, available time for analysis will often decrease, and time-consuming tools and techniques become more difficult for use in a timely manner. The control of the operation may still require decision support, but data collection and analysis will grow in importance.

At the end of the operation the analyst may be asked to support the evaluation of the mission. Tools and techniques used during the planning phase may be used again to determine the extent to which the operation arrived at the pre-defined objectives. Data collected during the operation can, or even should be, used to support procurement and policy studies and doctrine improvements in post-operation analysis.

In operations with a high operational tempo, time is limited. The demand is for tools and techniques that give results quickly. The operational tempo in warfighting operations will remain high. Operations with lower tempo (e.g. longer periods in Peace Support Operations) give the analyst additional time to use tools and techniques that are more detailed.

In an attempt to visualise these aspects, Figure 5.1 shows a possible distribution of techniques related to the phase of the operation. This figure is suggestive of the types of techniques that can be used in different types of operations **based on recent experiences**.

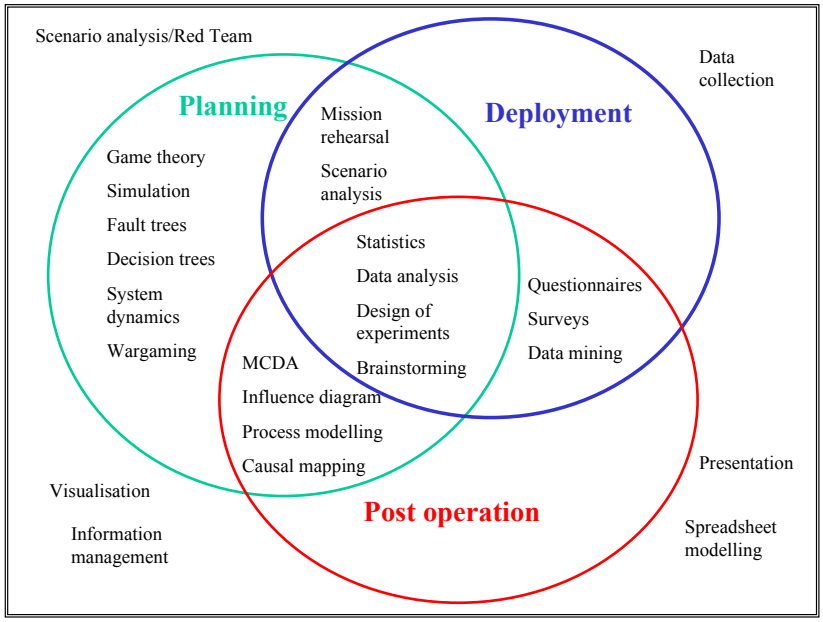

Figure 5.1: Possible Techniques for Varying Operational Phases.

5.3.2 A Software Suite for In-Theatre Support

This section suggests a suite of software for deployed analysts based on experiences gathered during a range of recent operations. To specify a helpful suite of software, special consideration is given to the

early phases of in-theatre support, where OA tasks are often similar across different types of operations. While the complexity of tasks may vary, the urgency is most likely high (quick response). Therefore, the application of tools should focus on the "quick" as opposed to the "perfect"; flexibility over customisation. Thus, the analysts will need a selection of simple, fast running tools/techniques that are flexible for a wide range of question, scenarios, situations and conditions.

This COBP will not suggest a fixed suite that should be used in all situations. Rather, it is a set of core tools that should be tailored according to the analyst's capabilities and the operational environment. These tools may not be available in theatre, so the analyst should be prepared to bring their own.

The suggested tools for inclusion in the software suite are:

5.3.2.1 Critical Tools

- Word processor, spreadsheet analysis, visual aids – for example, Microsoft Office™, Lotus Notes™
- Data base – for example, Microsoft™ Access
- Project management package
- A statistical package
- Information portability software – for example, WinZip™, Adobe Acrobat™
- E-mail software – for example, Outlook™

5.3.2.2 Suggested Additional Tools

- An all-purpose compiler
- A simulation package
- A mathematical package
- A geographic information system
- A decision support program
- Optimisation software
- Multi-criteria analysis software
- System dynamic software
- An image processing program
- A screen capture program

Possible existing tools within these general categories are presented in Annex C.

Readers may be surprised at the absence of simulation techniques in the software suite. Simulation modelling has a strong position in military OA environments and customised simulation models are often used in the preparatory phases before an operation or by a reachback element outside the theatre of operations. Simulation models may be of particular use when confronting a known enemy and scenario. In this situation, a model may be prepared in advance and used to provide 'quick' analysis when in theatre. However, this process is often complex and time-consuming.

As a result, customised simulation models will be of marginal value in theatre and are therefore not considered in this section.

While this suite will be helpful, it is important to be aware that the analyst is more important than the tools they use. Depending on the analyst's skills and background, specific tools are of less or more importance. Similarly, the suggested software will not enable "everyone" to provide OA support to a military operation. Training and experience in the use of relevant OA techniques is vital. A final consideration should be the compatibility of the chosen tools with the IT assets available within the HQ.

5.4 PRESENTATION OF ANALYSIS

Wherever possible, the OA cell should use a standard format to present the results of the analysis. This efficiency will save time, as a new format does not have to be invented for each output. It also establishes a recognisable OA style/trademark for the military customer. However, the analyst should be prepared to deviate from the standard format when required.

The standard format should include:

- A clear statement of the question/problem
- The customer
- The supplier, i.e. the analyst by name, section, contact number/e-mail address
- A short, up-front statement of the answer/result/recommendation
- The assumptions used
- Main text/discussion of the subject
- Reference to further detail if required (keeping the original output to one side of A4 if possible)
- Confidence limits, when possible

The OA cell should be prepared to accept tasks from the whole HQ and report back to the questioner using the standard format. If possible, one member of the OA cell (most likely the team leader) should try to attend the main events and meetings, as dictated by the HQ "battle rhythm". These provide opportunities to identify areas in which the commanders need advice without being specifically tasked, and enables the OA cell be proactive in their approach.

It is advisable, when possible during an operation, to show how OA is contributing, e.g. number and type of questions asked, how many have an effect on the decisions, and what is the effectiveness/impact of the analysis provided.

5.5 OPERATIONAL DATA

Operational Analysis needs data as input and will produce new data as a result. The data are used for analysis, recording lessons learned/noted, archive/research, version management and sources references. This can occur at any phase of an operation – planning, preparation, deployment, execution, recovery, and post-operations.

Metadata is defined by the Oxford English Dictionary as *"a set of data that describes and gives information about other data."* Essentially metadata comprises the sources and nature of the data collected for analysis.

This includes (in the OA case) the following aspects of the data: the time, data and location of collection or origin of the data; the collection method including the sensor(s), platforms and operators; the storage and transmission method; and the range of dissemination. It may also include the categorisation and processing methods of the data collected.

Most data considerations should be handled as early as possible in the planning and preparation phases. The data collection plan should be based on the anticipated analysis tasks, both during and after the mission. This is often overlooked. Wherever possible, the requirements of the data collection plan should be seen as an essential part of the planning for the operation.

During deployment and execution, it may be difficult to make significant adjustments and it may be possible that all the analysts' efforts are focused on implementing the collection plan. At the end of operations, every effort should be made to finish up the collection plan and catalogue and archive the data for timely exploitation. The data collected should be summarised as quickly as possible into salient facts, which can be used by leadership to respond quickly and effectively to key questions. If an operation continues, it is imperative to facilitate an effective data collection hand-over.

The need for post-conflict data collection should be acknowledged early and approved at as high a level as possible (especially if the requirement originates from areas outside the military command structure). Any experts required should be identified and trained as soon as the specific data collection requirements are known, and the resources that will be demanded in theatre to support the team need to be allocated during initial planning for the operation. Recent experiences have demonstrated that information management within the operational environment is not well understood, and this means that the OA cell may have to provide a local solution. It is not the scope of this text to provide an exhaustive manual on the proper handling and collection of data. Rather, the next paragraph will discuss some important information management issues for operational analysts in theatre.

5.5.1 Planning and Preparation

The collection of data during an operation is of crucial importance to analysis conducted both during and after operations. As such, the data requirements should be thought out before the operation starts. Some effort may have already been considered with a strategy to task decomposition of the operation: this should be capitalised on. It will not be possible to identify all data needs before deployment, but some preparatory work on the following questions could prove beneficial:

- What are the key things the commander will want to know?
- What measures of success will be used?
- Which data should be collected from the start?
- Where can data be found?
- What data is needed to use the tools brought into the theatre?

If analysts do not deploy to theatre, data collection may become impossible, or at the least very difficult. It is, therefore, even more important to ensure that data collection during the operation is seen as an essential part of the operation.

5.5.1.1 Handling and Storing Data

Data should be secured, catalogued, easily available and intuitive to other users. To secure this, the OA team should consider the following issues:

- **Bring large storage capacity** – Files are becoming huge, and in order to ensure post-operations access, it will need to be stored off line. Recent operations have created a substantial amount of data. For example, Desert Storm 1 created 3GB of data, whereas in contrast Operation Iraqi Freedom created 1TB (1TB=1000GB) of data. Do not underestimate the amount of data that may need to be stored.

- **Store data in searchable/queryable structures** – As the amount of data grows, it will grow progressively harder to search for and find the necessary information in a standard hierarchical file/catalogue structure. Databases (MS Access or other) or hyperlinked structures (web portals) can be used to catalogue data and make it easily available.

- **Ensure continuity/comparability of data** – Do not change the collection method, and perform data definition more often than necessary to avoid losing the ability to do trend or time series analysis.

- **Make the data intuitive for others** – Some metadata is required, especially to facilitate handover. Metadata should provide answers to "context" questions such as:
    - What questions was this data supposed to answer?
    - What methods were used?
    - What assumptions were used when the data was produced?

- **Look at automated tools for collecting and processing data** – New tools for data collecting and indexing will emerge in the years to come. See if these can be used to support the OA team's local information management. The use of an optical scanner and optical character reader software can simplify the initial conversion of data in paper form into initial electronic formats.

- **Ensure that the necessary information portability tools are available** – Information portability tools, for instance WinZip and Adobe Acrobat, are vital assets. If they are not available from the operation's information systems, the team should acquire them.

5.5.2 The Deployment Phase of an Operation

Upon arriving in theatre, analysts will have limited time to assess their situation, determine their tasks and set up to implement their data collection plan.

5.5.2.1 Set-up

Access is essential – This includes access to leaders, key meetings, areas requiring special clearances, and both routine and specialised networks. All of these are necessary to become aware of possible data sources and impending data requirements. Two key data items here are organisation charts and battle rhythms. It has also been found useful to arrive with a pre-prepared briefing (perhaps based on the two-page summary in Annex A) outlining the purpose of the OA team, which can be given to help orient both staff and visitors as to the role of OA.

5.5.2.2 Obtaining Data

Analysts have several options for securing the necessary data:

Collect the data themselves – This gives the team the best options to control data quality, and should ensure that the data is relevant for analysis. However, it is easy for the analysts to be bogged down with data collection full time, impacting their ability to perform the necessary analysis.

Self-initiated data collection should also be co-ordinated with the operation's information management section to avoid conflict due to encroachment on the responsibilities of others. Plan ahead, ensure that manning is sufficient to execute this approach and use the appointed data manager.

Get others to do the work for them – In some instances, other participants in the operation (e.g. information management section, personnel in the field, historians) might be persuaded to find and

collect data for the OA team, as long as they are provided with a clear specification of what to look for. This frees time for the OA team, but will similarly reduce the collectors' time for their regular work. Because of this time cost, the analysts should ensure that data collected by others is useful for decision-making and not gathered just to satisfy the team's curiosity. Reachback may be used to accomplish some of the intense data collection, if the data is available over networks.

Look at already collected data – To lighten the burden of data collection, it may be helpful to look at data already collected for another purpose. One possibility is to look at standard NATO tools used in theatre (for instance ADAMS) as a source for data.

5.5.3 The Execution Phase of an Operation

This is inevitably a very busy part of any operation, but until an analyst has experienced this, they will never fully understand its intensity and stress. It is essential to ensure that terms of reference are in place that permit analysts to collect data that may be outside of the scope of the team's stated mission. Below are some key considerations:

- **Data comes in different types, from different sources and at different times within the operation** – While these data are likely to be incomplete, access to it is essential.
- **Business practices and data entry protocols are early casualties of operations** – Unless one is diligent in pursuing data, it may not be available – it may never be entered in the information systems of record and must be sought elsewhere.
- **Data is often perishable and must be collected regularly** – A solid data collection plan/concept of operations is recommended. One approach to the management of information is either to place OA and record keeping under the same cell within a HQ, or to task the OA cell with the record keeping. The latter option may help addresses issues relating to the loss of data required for post-operations analysis.
- **The amount of data grows rapidly** – Managing this information flow is a huge challenge that is not practicable during peacetime operations.
- **Data quality will be an important issue for the analysis team** – The following questions should be considered when using available data:
    - How reliable are the data?
    - Which unit measures are used?
    - Are the data raw or interpreted?
    - What are the sources of the data? Can they be used freely?
- **Data collected by others**
    - Are these really the data you need (validity)?
    - Who has been collecting these data and why?
    - Does the collector interpret the terminology the same way as you?
    - Does the collector have a bias you need to be aware of?

5.5.4 Post-Operation Data Collection

All types of military operations provide an opportunity to collect data on the performance and effectiveness of forces and equipment. Indeed, one of the important secondary roles of deployed analysts, in addition to providing decision support to the commander, may be collecting data.

For example, warfighting operations, offer rare (and these days usually fleeting) opportunities to evaluate highly complex systems under the actual conditions for which they were designed, and to examine the wider aspects of human behaviour and decision-making in a real combat environment. Data collected to support such evaluations do not directly contribute to operational decision-making. However, the resulting evaluations may well be extremely useful in support of future technical and procurement decisions or doctrine development.

The data that need to be collected will generally be additional to those which are normally required for the efficient conduct of operations (as noted in section 5.5.3), or which are already acquired as a matter of course for legal or administrative reasons. The collection of such specialist data is likely to be beyond the resources or expertise of the deployed forces and their supporting analysts.

At the end of hostilities, therefore, there may be a requirement to deploy teams of experts and analysts to collect data. This will necessitate civilian specialists working in what had, until recently, been (or may even still be) a war zone, which introduces problems in addition to those of deploying trained analysts to support headquarters. Deployment of analysts in support of the commander should (and particularly if the guidance given elsewhere in this document has been followed) be a relatively automatic process: the principle of analyst deployment should have been accepted in advance, the analysts should have been trained and prepared, and resources for their support and sustainment allocated.

Recent experiences with the deployment of data collection teams are that their composition and demand on resources in theatre are likely to be ad-hoc and conflict dependent. The particular experts required and what they need to conduct their business will, for example, be highly dependent on the weapons or systems of interest, and the types of targets against which they were used. This can raise major issues of training and preparation, of authorisation to deploy, and additional demands on resources in theatre for their protection and support.

The following issues should therefore be addressed, as early as possible, if it is anticipated that there will be specialised data collection requirements at the end of a conflict.

5.5.4.1 Timeliness

It is essential that data are collected as soon as it is safe to do so following the end of hostilities, in order to avoid contamination or destruction of the physical evidence, or loss of corporate memory as personnel return from theatre. This implies that the requirement to collect data has been anticipated, and key experts given the necessary training and preparation in advance, so that they can be deployed without delay once the security situation permits.

5.5.4.2 Authorisation

Data collection of this type is likely to involve civilians (and possibly military personnel not deployed with their units as part of the operation) with specialist knowledge visiting areas which may still be hazardous due, for example, to residual enemy action, mines and unexploded ordnance. Data collection teams will, unless the areas visited are particularly convenient and the environments benign, need to be self-sufficient. Transport, force protection, communications and EOD support will all need to be available and under the control of the team over a period of weeks. Provision of military personnel from the home-base (so that they do not have to be found from units already in theatre) is likely to be well received.

5.5.4.3 Team Composition

The impetus for data collection is likely to originate from outside the operational command structure (for example, from scientific, technical and legal organisations). There may well, therefore, be a conflict between an operational commander's wish to remove personnel from theatre at the end of hostilities and the requirement to deploy additional staff, with an implied extra demand on resources. It is, therefore, important that high level approval is sought at an early stage from within the military command structure, and if possible, the data collection requirement should be included in initial planning directives rather than as an afterthought at the cessation of hostilities.

5.5.4.4 Planning

The provision of such support to the data collection team is likely to conflict with other high priority demands on resources. This situation can be alleviated if provision of the necessary assets can be made at the planning stage and, ideally, those assets earmarked for the purpose of data collection rather than being allocated between a number of competing tasks on the basis of priorities perceived at the time. This is where high level agreement on the need for data collection is essential, and co-ordination with the theatre commander is crucial to success.

5.5.5 Equipment

The specialist equipment required (other than that needed to ensure the team's mobility and safety) will obviously depend on what systems and effects are to be investigated. However, the following are useful in almost all circumstances and should form the core of what is taken by the team:

- Laser rangefinder
- Satellite telephone
- Digital camera
- Tape recorder/Dictaphone
- Laptop computer (with an encrypted drive if, as is likely, it is necessary to handle classified information)
- GPS receiver
- Power supplies (inverters or means for recharging batteries from vehicle batteries)

Chapter 6 – RECENT EXAMPLES AND LESSONS IDENTIFIED

6.1 INTRODUCTION

This section comprises recent decision support experiences and lessons learned from national and NATO HQs. It includes specific examples of OA used in decision support in operational situations. The examples are intended to offer **guidance** to analysts and military staff as to the nature of tasks that OA can address in the support of military command decision-making. It should also offer guidance as to the best methods for working on various OA tasks.

6.2 EXAMPLES OF OA ANALYSIS AND DECISION SUPPORT

Generally it can be stated that the principal role of the analyst is to convert data into knowledge. Examples of analysis which may be provided by an OA team in the different phases of an operation are included in Section 2.2.

This section contains details of generic and specific examples of OA applications offering decision support to Component and Combined/Joint HQs. They cover the range of operations from peace support operations (PSO), i.e. non warfighting, to medium scale warfighting. Tables 6.1 and 6.2 list the examples and refer each to a more detailed description in Annex D. Table 6.1 shows generic examples. The examples in Table 6.2 focus on a specific situation. For each example, the following characteristics are given:

- Background – circumstances of the operation and the issue requiring decision support
- OA Action – task required of the OA team
- Timescale – time available for analysis
- Data requirements – type and detail of data required to analyse the subject issue
- Decision supported – the commander's decision(s) as supported/advised by the OA advice
- Report format
- Significant lessons – any significant lessons identified as a result of the OA study

Table 6.1: Generic Examples of OA Applications offering Decision Support to Component and Combined/Joint HQs

Generic Examples for OA in Support of Military Operations			
Class/Title	**Phase**	**Keywords**	**Annex No.**
Peace Support Operations	Execution	Cessation of hostilities; Measures of Normality; Crime rate; Commodities; Utilities availability.	D1.1
Warfighting	Planning	Force comparison; Weapon performance; Accuracy of weapons; Measures of Effectiveness; Success Indicators	D1.2

Table 6.2: Specific Examples of OA Applications in offering Decision Support to Component and Combined/Joint HQs

Specific Examples of OA in Support of Military Operations			
Class/Title	**Location/Phase**	**Keywords**	**Annex No.**
Measures of Normality			D2
Overall measures of normality	Balkans/ Planning and Execution	Crime; Commodities availability; Utilities; Violations of ceasefire	D2.1
Crime rate measure	Balkans/Execution	Serious crime; Attacker/victim ethnicity	D2.2
Measures of Campaign Success/Progress			D3
Campaign success	Afghanistan/Execution	ISAF I; Crime statistics; Patrol reports	D3.1
Risk Assessment			D4
Security measures	Afghanistan/ Planning and Execution	Control and processing of delegates; Security	D4.1
Risk from rebel force attack	Sierra Leone/ Planning and Preparing	Friendly and enemy order of battle; Fire support	D4.2
Contingency Planning			D5
Force withdrawal from PSO (war starts)	Bosnia/ Planning and Recovery	Withdrawal from PSO during actual change to warfighting, escalation	D5.1
Air Support	Kosovo/ Planning, Preparing	Land, limited Air support	D5.2
Prisoner of war handling	Gulf War 2003/ Planning and Preparing	Surrender rate; Guarding requirement; Law of Armed Conflict	D5.3
Course of Action Assessment			D6
Air attack effectiveness	Balkans air war/Execution	Weapon usage, precision weapon scarcity implications	D6.1
Urban close air support	Gulf War 2003/Execution	Weapon accuracy, destructive power; Collateral damage	D6.2
Measuring Enemy Capability			D7
Force ratio for attack planning	Desert Storm 1991/ Planning and Preparing	Casualties; Friendly and enemy order of battle (ORBAT); Weapon performance	D7.1
Integrated Air Defence System (IADS)	Desert Storm 1991. Kosovo 1999. Gulf War 2003/ Planning and Preparing	Suppression of Enemy Air Defences (SEAD)	D7.2
Mission Evaluation			D8
Mission evaluation	Afghanistan/Execute and Post-operations	ISAF III, Mission Evaluation	D8.1
Technical Issues			D9
Ship visibility/camouflage	Gulf War 2003/ Planning and Preparing	Visual detection; Climatology; Counter shading	D9.1
Ship vulnerability	Adriatic 93-95/ Planning and Preparing	Sea mine threat; Airborne sensor performance	D9.2

Chapter 7 – GLOSSARY

ACE	Allied Command Europe
ACO	Allied Command Operations
ACOS	Assistant Chief of Staff
AO	Area of Operations
AOR	Area of Responsibility
ARRC	Allied Command Europe (ACE) Rapid Reaction Corps
ASW	Anti-Submarine Warfare
AWW	Above-Water Warfare
CA	Campaign Assignment
CE	Crisis Establishment
CIMIC	Civil Military Co-operation
CIS	Computer Information System
CJO	Chief of Joint Operations
CJTF	Combined Joint Task Force
COA	Course of Action
COBP	Code of Best Practice
CONPLAN	Concept of Plans
COS	Chief of Staff
DCOS	Deputy Chief of Staff
DPL	Applied Decision Analysis DPL (commercial software)
DU	Depleted Uranium
EOD	Explosive Ordnance Device
FR	Functional Review
GB	Gigabyte
GFAP	General Framework Agreement for Peace
GIS	Geographic Information System
GWOT	Global War On Terrorism
HQ	Headquarters
IADS	Integrated Air Defence System
ID	Identification
IFOR	Implementation Force
IO	Information Operations
ISAF	International Security Assistance Force
IT	Information Technology
JTF	Joint Task Force
KFOR	Kosovo Force
km	Kilometre
LAN	Local Area Network
LCC	Local Component Commander
LJ	Loya Jirga
LOAC	Law Of Armed Conflict

MCM	Mine Counter-Measures
MCMV	Mine Counter-Measure Vessels
MNB(C)	Multinational Brigade Centre
MOD	Ministry of Defence
MOE	Measure of Effectiveness
MS	Microsoft
MWC	Maritime Warfare Center
NATO	North Atlantic Treaty Organisation
NBC	Nuclear, Biological and Chemical
NC3A	NATO Consultation, Command and Control Agency
NCS	NATO Command Structure
NEO	Non-Combatant Evacuation Operation
NGO	Non-Government Organisation
OA	Operational Analysis
OAT	Operations Analysis Team
OR	Operational Research
ORBAT	Orders of Battle
ORSA	Operations Research/Systems Analysis
PJHQ	Permanent Joint Headquarters
POC	Point of Contact
POW	Prisoner of War
PSO	Peace Support Operations
RHQ	Regional Headquarters
SA	Situational Awareness
SAM	Surface-to-Air Missile
SAS	Studies, Analysis and Simulation
SEAD	Suppression of Enemy Air Defence
SFOR	Stabilisation Force
SHAPE	Supreme Headquarters Allied Powers Europe
SI	Success Indicators
SO	Staff Officer
SOP	Standard Operating Procedure
SOFA	Status of Forces Agreement
SPSS	Statistical Package for the Social Sciences (commercial software)
STUFT	Ships Taken Up From Trade
TB	Terabyte
TG	Task Group
UCAS	Urban Close Air Support
UK	United Kingdom
UN	United Nations
US	United States (of America)
USAREUR	United States Air Force Europe
USB	Universal Serial Bus
WW2	World War 2

Chapter 8 – BIBLIOGRAPHY

BOOKS ON GENERAL OPERATIONAL RESEARCH

Pidd, Michael, *Tools for Thinking: Modelling in Management Science*. 1st edition. Chichester: John Wiley & Sons (1996).

Mitchell, George, *The Practice of Operational Research*. 1st edition. Chichester: John Wiley & Sons (1993).

Taha, Hamdy A., *Operations Research: An Introduction.* 6th edition. New Jersey: Prentice Hall (1997).

Miser, Hugh J. and Quade, Edward S. (eds), *Handbook of Systems Analysis*. 1st edition. New York: John Wiley & Sons.

Keys, Paul (ed), *Understanding the Process of Operational Research: Collected Readings*. 1st edition. Chichester: John Wiley & Sons (1995).

Gauss, S.I. and Harris, C.M., *Encyclopaedia of Operations Research and Management Science.* Centennial Edition. Hingham MA: Kluwer Academic (2001).

Optimisation Methods

Williams, H. Paul, *Model Building in Mathematical Programming*. 4th edition. Chichester: John Wiley & Sons (1999).

Vanderbei, R.J., *Linear Programming: Foundations and Extensions*. 1st edition. Boston: Kluwer Academic Publishers (1997).

Reeves, Colin (ed), *Modern Heuristic Techniques for Combinatorial Problems*. 1st edition. New York: McGraw-Hill (1995).

Simulation

Pidd, Michael, *Computer Simulation in Management Science*. 4th edition. Chichester: John Wiley & Sons (1998).

Law, Averill and Kelton, W. David, *Simulation Modeling and Analysis*. 3rd edition. McGraw-Hill (2000).

Data Envelopment Analysis

Thanassoulis, E., *Introduction to the Theory and Application of Data Envelopment Analysis: A Foundation Test with Integrated Software.* 1st edition. Hingham MA: Kluwer Academic (2001).

System Dynamics

Coyle, R.G., *System Dynamics: A Practical Approach*. 1st edition. London: Chapman & Hall (1996).

Vennix, J.A.C., *Group Model Building: Facilitating Team Learning Using System Dynamics*. 1st edition. Chichester: John Wiley & Sons (1996).

Wolstenholme, E.F., *System Enquiry: A System Dynamics Approach*. 1st edition. Chichester: John Wiley & Sons (1990).

Journal of the Operational Research Society **50:** Part 4 (1999) was a special issue on 'System Dynamics for Policy Strategy, and Management Education'. Its 18 papers give a good overview of current applications of the technique.

Forecasting

Makridakis, S., Wheelwright, S.C. and Hyndman, R.J., *Forecasting: Methods and Applications.* 3rd edition. Chichester: John Wiley and Sons (1998).

Logistics Topics

Waters, C.D.J., *Inventory Control and Management.* 2nd edition. Chichester: John Wiley and Sons (2003).

Decision Analysis

Goodwin, Paul and Wright, George, *Decision Analysis for Management Judgment*. 2nd edition. Chichester: John Wiley & Sons (1998).

Belton, Valerie and Stewart, Theodore J., *Multiple Criteria Decision Analysis: An Integrated Approach*. 1st edition. Boston: Kluwer Academic (2001).

Forman, E.H. and Gass, S.I., The Analytic Hierarchy Process – An Exposition. *Operations Research* 49: 469-486 (2001).

'Soft' Methods

Rosenhead, Jonathan and Mingers, John (eds), *Rational Analysis for a Problematic World Revisited: Problem Structuring Methods for Complexity, Uncertainty and Conflict*. 2nd edition. Chichester: John Wiley & Sons (2001).

Checkland, Peter B., *Systems Thinking, Systems Practice*. 1st edition. Chichester: John Wiley & Sons (1981).

Checkland, Peter B. and Scholes, James, *Soft Systems Methodology in Action*. 1st edition. Chichester: Wilson, Brian. *Soft Systems Methodology – Conceptual Model Building and its Contribution.* Chichester: John Wiley & Sons (2001).

Wilson. B., *Soft Systems Methodology – Conceptual Model Building and its Contribution.* Chichester: John Wiley and Sons (2001).

Eden, Colin and Ackerman, Fran, *Making Strategy: The Journey of Strategic Management*. 1st edition. London: Sage Publications (1998).

Van der Heijden, Kees, *Scenarios: The Art of Strategic Conversation*. 1st edition. Chichester: John Wiley & Sons (1996).

Game Theory

Dutta, Prajit K. (ed), *Strategies and Games*. 1st edition. Cambridge (Mass): MIT Press (1999).

Coleman, Andrew M., *Game Theory and its Applications*. 2nd edition. Taylor & Francis (1995).

Queuing Theory

Gross, Donald and Harris, Carl M., *Fundamentals of Queuing Theory*. 3rd edition. New York: John Wiley & Sons (1997).

BOOKS, PAPERS AND JOURNALS ON DEFENCE OPERATIONAL RESEARCH AND ANALYSIS

General Surveys (Recent)

Hughes, Wayne P., Jr. (ed), *Military Modeling for Decision Making*. 3rd edition. Alexandria: Military Operations Research Society (1997).

Jaiswal, N.K., *Military Operations Research: Quantitative Decision Making*. 1st edition. Boston: Kluwer Academic Publishers (1997).

Shephard, R.W., Hartley, D.A., Haysman, P.J., Thorpe, L. and Bathe, M.R., *Applied Operations Research: Examples from Defense Assessment*. 1st edition. New York: Plenum Press (1988).

Bracken, J., Kress, M. and Rosenthal, R.E. (eds), *Warfare Modeling*. 1st edition. Alexandria: Military Operations Research Society.

Mylander, W. Charles and Wagner, Daniel H. (eds), *Naval Operations Analysis*. 3rd edition. Annapolis: US Naval Institute Press (1999).

Przemieniecki, J.S., *Mathematical Methods in Defense Analysis*. 3rd edition. Reston, Virginia: American Institute of Aeronautics and Astronautics (2000).

Classic Works

Morse, Philip M. and Kimball, George E., *Methods of Operations Research*. 1st edition. Cambridge (Mass) and New York: Technology Press of MIT and John Wiley & Sons (1950).

Quade, Edward S. (ed), *Analysis for Military Decisions*. 1st edition. Chicago: Rand McNally (1964).

Hitch, Charles J. and McKean, Ronald N., *The Economics of Defense in the Nuclear Age*. 1st edition. Cambridge (Mass): Harvard University Press (1960).

Lanchester, Frederick W., *Aircraft in Warfare: The Dawn of the Fourth Arm*. London: Constable (1916).

BOOKS ON SPECIALISED DEFENCE-RELATED TOPICS

Analysis of Historical Data

Hartley, D.S., *Predicting Combat Effects*. 1st edition. Arlington: Military Applications Society, INFORMS (2001).

Weapon Allocation and Target Damage

Eckler, A.R. and Burr, S.A. (eds), *Mathematical Models of Target Coverage and Missile Allocation.* Reprint of the original 1972 series Alexandria: Military Operations Research Society (2001).

Mathematical Modelling of Combat

Bowen, K.C. and McNaught, K.R., Mathematics in Warfare: Lanchester Theory. In: Fletcher, John. *The Lanchester Legacy, Volume III – A Celebration of Genius*. Coventry: Coventry University (1996).

Taylor, J.G., *Lanchester Models of Warfare*. In two volumes. 1st edition. Arlington: Military Applications Section, INFORMS[1] (1983).

Taylor, J.G., *Force-on-Force Attrition Modeling*. 1st edition. Arlington: Military Applications Section, INFORMS (1981).

Anker, C.J., Jr., *One-on-One Stochastic Duels*. 1st edition. Arlington: Military Applications Section, INFORMS (1982). [Appears to be no longer available from the publishers]

Ancker, C.J. and Gafarian, A.V., *Modern Combat Models: A Critique of their Foundations.* Arlington: Military Applications Society, INFORMS (1992). A volume in the INFORMS 'Topics on Operational Research' series.

Combat Simulations

Moffat, J., *Command and Control in the Information Age: Representing its Impact.* 1st edition. London: The stationery office (2002).

Speight, L.R., '*Structural Variance' or 'Non-Mononticity' Effects in Combat Models: A Review*. Military operations research **8** (1) 17-42 (2003).

Search Theory

Koopman, B.O., *Search and Screening*. 1st edition. New York: Pergamon Press (1980). The 1980 edition was reprinted in 199 by the US Military Operations Research Society and is obtainable from the MORS Office.

Stone, L.D., *Theory of Optimal Search*. 1st edition. New York: Gordon and Breach (1975).

Washburn, A.R., *Search and Detection*. 1st edition. Arlington: Military Applications Section, INFORMS (1981).

Blenoski, S.J., Monticini, M.G. and Weisinger, J.R., *A Survey of the Search Theory Literature.* Naval Research Logistics **38:** 469-494(1991).

Games and Gaming

Bowen, K.C., *Research Games*. 1st edition. London: Taylor & Francis (1978).

Perla, Peter D., *The Art of Wargaming*. 1st edition. Annapolis: US Naval Institute Press (1990).

Journals

The *Military Operations Research* is published roughly quarterly by the US Military Operations Research Society. The MORS newsletter, Phalanx, also has interesting technical articles.

[1] INFORMS is the Institute for Operations Research and Management Science. It is the principal US OR society.

The *Naval Logistics Research* has a stated policy of publishing defence-related papers, but only infrequently has the opportunity to do so. It has a continuing connection with the US Naval Postgraduate School at Monterey, California but is essentially a general OR journal.

Mainstream OR journals include the *Journal of the Operations Research Society, Interfaces* (the application-orientated journal of INFORMS), *Operations Research* and *Management Science.*

History of Defence Operational Research

Körner, T.W., *The Pleasures of Counting*. Cambridge University Press (1996).

Kirby, M.W. and Capey, R., The Origins and Diffusion of Operational Research in the UK. *J Opl Res Soc* **49**: 307-326 (1998).

Kirby, M.W. and Capey, R., The Air Defence of Great Britain, 1920-1940: An Operational Research Perspective. *J Opl Res Soc* **48**: 555-568 (1997).

Kirby, M.W. and Capey, R., The Area Bombing of Germany in World War II: An Operational Research Perspective. *J Opl Res Soc* **48**: 661-677 (1997).

Waddington, C.H., *OR in World War II: Operational Research against the U-Boat*. London: Elek Science (1973).

Blackett, P.M.S., *Studies of War*. 1st edition. London: Oliver & Boyd (1962).

Copp, T., Scientists and the Art of War: Operational Research in 21 Army Group. *Journal of the Royal United Services Institution,* Winter 1991, 65-69 (1991).

Copp, T. (ed), *Montgomery's Scientists: Operational Research in Northwest Europe: The Work of No. 2 Operational Research Section within 21 Army Group, June 1944 to July 1945.* Waterloo, Ontario, Laurier Centre for Military Strategic and Disarmament Studies (2000).

Trefethen, Florence N., A History of Operations Research. In: McCloskey, J.F. and Trefethen, F.N., *Operations Research for Management*, Volume 1. The Johns Hopkins University Press (1954). Reprinted in: Keys, Paul (ed). *Understanding the Process of Operational Research: Collected Readings*. 1st edition. Chichester: John Wiley & Sons (1995).

Chapter 9 – TEAM MEMBERS

Ist Lt B. Boga Bakirli	Birceboga@yahoo.com
Mr A. Bell	a.bell@eastlant.nato.int
Mr R. Bird	Richard.Bird@ramstein.af.mil
Mr O. De Bayser	Olivier.debayser@cad.etca.fr
Major D. Dinger	David.dinger@wpc.af.mil
Ms M. Fisher	Fisherm@afnorth.nato.int
Mr J. Frelin	Jan.frelin@foi.se
Mr H. Fridheim	Hfr@ffi.no
Dr S. Gordon	Steve.gordon@afams.af.mil
Mr P. Hingst	James.hingst@pentagon.af.mil
Dr S. Lockwood	Steven.Lockwood@nc3a.nato.int
Mr A. Murashige	Allen.murashige@pentagon.af.mil
Ms C. Nichols	Crnichols@dstl.gov.uk
Miss S. O'Brien	Sobrien@dstl.gov.uk
Mr N. Reid	Nreid@dstl.gov.uk
Mr H. Richardson	Oab1@bfgnet.de
Dr G. Rose	Grose@dstl.gov.uk
Dr L. Ruskell	Leruskell@dstl.gov.uk
Mr H. Schirlitzki	Schirlitzki@iabg.de
Lt Cmdr G. Smith	Smithfamily46@hotmail.com
Mr P. Stoddart	Pjstoddart@dstl.gov.uk
Mr F. Toevank	Toevank@fel.tno.nl
Captain H. Toyoglu	Htoyoglu@kkk.tsk.mil.tr
Mr G. Van den Dobbelsteen	Vandendobbelsteen@tm.tno.nl
Mr C. Wiersum	Wiersum@fel.tno.nl
Major S. Williams	Scott.Williams@wpc.af.mil
Lt Col D. Woermann	Dwoermann@afsouth.nato.int

The above list represents those team members who have provided a substantial contribution to the development of this document. It is not possible to accurately list all the individuals who have also provided invaluable comments and reviews during the development of this document, however the Chair passes on his thanks to them.

Annex A – COMMANDER'S SUMMARY DOCUMENT

INTRODUCTION: The purpose of this document is to provide CJTF (Combined Joint Task Force) and Component commanders and their staffs with an overview of operational analysis (OA). Two important definitions from the NATO Code of Best Practice (COBP) on Decision Support for CJTF and Component Commanders are:

- *Operational Analysis: "application of scientific methods to assist executive decision-makers"*
- *Decision Support: "application of the best available analytical tools/techniques to support the decision process"*

This document will frame operational analysis by answering the 5 "W's" and "H": ***Why, What, When, Where, Who and How***. A more thorough description can be found in the COBP on Decision Support for CJTF and Component Commanders.

***WHY* have analysts been successfully used in recent operations?**

Historically, commanders' (and their staffs') decision processes – and ultimately the decisions themselves – were improved when operational analysis was applied. Previous examples of OA support to operations include:

- **DESERT STORM** – Warfighting Operations
  -- OA support was used to develop the 1 (UK) Armd Division plan.
- **PSO-Balkans** – Peace Enforcement/Keeping
  -- OA defined/measured indicators of "compliance and normality"
- **ALLIED FORCE** – Warfighting Operations
  -- OA collected/synthesized/analyzed allied combat munitions effectiveness and Battle Damage Assessment
- **ISAF** – Peace Support Operations
  -- OA included compliance and stability monitoring and Info Ops assessment

In more generic terms, OA can improve decision-making throughout the commander's decision cycle (Figure 1).

NATO Operational Planning Process Overview

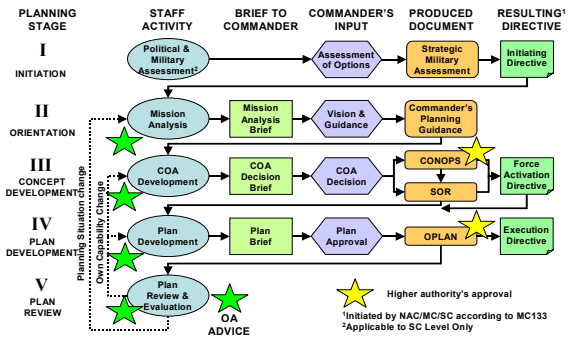

Figure 1: NATO Operational Planning Process Overview.

***WHAT* problems can OA address?**

OA can address a wide range of problems and assist in finding a solution through the structuring, collating and organization of data. Examples where OA can make substantial contributions include:

- **In Barracks**
  - Contingency Planning/COA Analysis
  - Support with Exercise Planning
  - Liaison with wider analysis communities
- **On Exercises**
  - Ensure realism/coherence of the Exercise
  - Part of HQ; testing OA decision support
  - Assess the performance of the HQ
- **On Operations**
  - Operational/Contingency Planning
  - Measurement of Campaign Success
  - Data Collection and Analysis
  - Lessons Learned

Figure 2 displays actual analyses performed to help monitor and improve peacekeeping operations at ISAF.

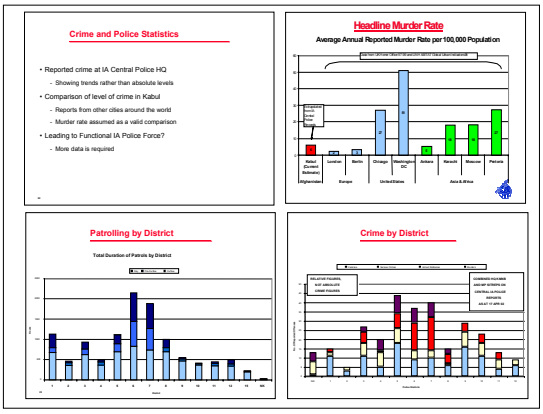

Figure 2: Example of Analyses from ISAF.

***WHEN* do I use operational analysis?**

Operational Analysis can contribute during all phases of an operation. Naturally, the type of support and activities will vary depending on the operational phase. Historically, operational analysis has been most effective during actual operations when it was included early in the planning phases of that operation. Typically, OA contributes during peacetime in the policy/procurement arenas, but OA in direct support to commanders varies in several aspects:

- **Timeliness** – typically answers within 2-72 hours
- **Data** – current/near-term; usually incomplete
- **Problem Owner** – individual vs. community
- **Quantity** – small numbers of deployed analysts
- **Scope** – wide range of problems to solve
- **Constraints** – time and what's available in theatre
- **Completeness** – 80% solution usually sufficient

As a general rule, it's best to use OA early and often!

***WHERE* are operational analysts located?**
Given that OA ideally occurs in peacetime and crisis, OA can and should occur both "in barracks" and "out of barracks". Optimally, OA should be included in forward deployed opportunities whenever possible (exercises, operations, post-operations). Figure 3 depicts a deployed JTF (which includes OA personnel and facilities). Operational Analysis can be conducted at multiple locations simultaneously:

- **Forward Deployed** – small team of analysts embedded into the commander's staff (Figure 4)
- **Reachback** – the larger analytical/scientific community may provide specific expertise not easily deployed

Figure 3: Deployed JFLCC Compound (HQ ARRC).

Figure 4: Deployed Operational Analysis Team.

In the COBP on Decision Support for CJTF and Component Commanders, various options for the placement of the OA team within the commander's organization are described – from working directly for the chief of staff, to being embedded in the planning cell. Ultimately, the location of the OA team will depend on the specific operation and needs of the commander.

***WHO* are operational analysts?**
Operational analysts are a mixture of civilians and military officers. Team members can be both male and female, and include not only multiple services but multiple nations as well. As a goal, OA teams will include at least one military officer. However, the team leader will often be civilian. It is essential that the team leader not only be technically competent but also is credible with military commanders, and has good access to the reachback OA team/ organization. The importance of the deployable scientist's personality and overall training becomes apparent when considering team issues:

- Cramped accommodations/work areas
- Successful team templates of 2, 4 or 6 (mission dependent) people working in pairs.
- Need for 24-hour manning
- Individuals must be suitably fit for deployed operations (inoculations, some physical endurance, etc.)

***HOW* do I use operational analysts?**
Both commanders/staffs **AND** the operational analysts themselves are responsible for ensuring successful use of operational analysis. A short version of the analysts' values is depicted in Figure 5.

Analysts' values

- Be loyal
- Be frank yet tactful
- Be proactive
- Be 100% honest
- Be an expert
- Be helpful
- Be a team player
- Be a smart worker
- Be timely

Figure 5: Analysts' Values.

Additionally, commanders and their staffs need to know ways **THEY** can help the analysts succeed. Three "How's" for their consideration:

- **Best Way to Use Analysis**
  - Ensure analysts have access to data and staff
  - Endorse/advocate OA activities
  - Be aware forward team does have access to rear party and reachback analysts/organizations
- **Poor Use of Analysts**
  - Manpower pool for "Action Officers" (i.e. using them as PowerPoint Rangers)
  - Full-time data collectors and administrators
  - Lessons-Learnt administrators (although they can help analyse/synthesize the lessons)
- **Limitations/Risks You Should Know**
  - Force protection (many analysts are NOT military personnel)
  - Predictive analysis is VERY limited
  - Science vs. Art (not all problems will be analysts strong-suit, e.g. quantitative)
  - Task Saturation (very small OA team forward)

SUMMARY: This document only provides a cursory overview of Operational Analysis. All operational analysts **MUST** read the NATO COBP on Decision Support for CJTF and Component Commanders; CJTF and Component commanders and their staffs seeking a deeper understanding **SHOULD** do so as well!

Annex B – OPERATIONAL ANALYSTS ON DEPLOYMENT

B.1 SELECTION AND FITNESS OF PERSONNEL

All deployable analysts require a level of physical and mental fitness that will support working long hours, under pressure and in less than ideal conditions. Deployment working and living conditions can vary significantly in terms of working hours, pressure and facilities for eating, sleeping and washing. An integral part of the selection process for a deployable scientist is the ability to pass a medical of similar standard to that used within the armed forces.

The most demanding deployments are likely to be those to Land Force HQs and units located in remote regions with limited facilities, harsh environmental conditions and a high threat environment. For such cases, the deployed analyst requires a level of physical fitness comparable to that of the *general* military personnel with whom they will be working. Suitable candidates will be able to work long hours in uncomfortable conditions, and have the ability to carry all personal clothing and equipment between transport that may be a few kilometres apart.

Less demanding deployments could be HQs, where the work is done in a standard office and accommodation is in a reasonable standard hotel, compared to airbases where the accommodation, washing and feeding facilities may be all communal, and the working environment is cramped with few facilities. In the former, staff with severe medical conditions (e.g. asthma or diabetes) may still be suitable (providing that the appropriate medical support is readily available) and the main physical fitness requirement is the ability to work long hours under some pressure. In the latter, a higher state of fitness and mental resilience is required, but many staff should be capable of achieving the standard.

Scientific staff who are deploying should also receive the standard inoculations given to soldiers in peacetime, as prescribed by National Policy. Generally the required inoculations are

- Diphtheria
- Tuberculosis
- Tetanus
- Hepatitis A
- Polio
- Typhoid/typhus
- Influenza
- Yellow fever
- Rabies and Anthrax may also be required

Inoculations may require a booster or renewal prior to any deployment. It is important that individuals know their own blood group for their documentation. Scientific staff should also be given advice on avoiding toxic threats, as well as heat and cold injuries.

When on deployment, all staff should also have an adequate supply of any medication taken on a regular basis (both prescriptive and non-prescriptive), and every member of staff should be advised to have a dental check up before deploying. It is also advisable to take a supply of ‘over-the-counter’ medication for sore throats, headaches and the common cold.

B.2 DOCUMENTATION AND MOBILISATION

Please note that this Annex is based on current UK practice – other Nations and NATO will have equivalent documentation requirements.

Any deploying scientific staff should have the following documentation:

- Government Identity card
- F/Ident/108 (or national equivalent) which gives civilians the right to be treated as Prisoners of War
- A copy of the deployment order for that operation, including kit lists
- Passport – this should have at least 12 months to run at time of deployment **plus any visas required**
- Dog tags which should show name, nationality, type of employment (e.g. MOD Civilian), staff number, blood group and religion
- IT Carriage and classified document courier certificate
- Next of kin form must be completed and up to date. Individuals should ensure that the personnel department has a current copy and the individual should carry another copy
- Staff are advised to update their will and appoint an executor
- Staff are advised to ensure that any life insurance is up to date and is valid to cover their deployment to support a military operation (e.g. to cover a mortgage)
- Review signature authority on personal financial assets
- Appoint a guardian for minor children if required
- Review 'Nominations of Beneficiaries' form on personal file with respect to pension and associated death in-service benefits

Copies of the deployment order and travel order **must** be taken on the deployment. Security clearances will need to be forwarded to the relevant HQ (in the UK, at least, there is no certificate as such that you can take with you – the Security officer must send clearance as appropriate).

If, unfortunately, a member of the scientific staff dies whilst on deployment, everything possible will be done to assist the surviving family. This includes liaising with staff in theatre to obtain a formal death certificate (for satisfactory insurance claims), military mortuary service and transport of the remains to the country of burial. Deploying staff and their families should understand that civilian agencies would have limited ability to influence events in such a case.

Journeys to, within and from an operational theatre tend to be uncomfortable, slow and unreliable. It is best to be prepared for unexpected delays, for example by carriage of a supply of water and sleeping bags, even for short journeys. It is also advisable not to book expensive commitments such as holidays immediately after the expected return date, in case of delay.

Any deploying staff should be aware of their agencies rules on working hours/over time accrued during deployment. Staff should be aware of how to correctly submit and keep records of their hours worked, and the definition of over time.

All staff should be aware of what currency and credit cards are acceptable in the country/HQ to which they are deploying. It is advisable to take cash when deploying, which may be converted into the local currency once deployed.

An example checklist of preparations for deployment is shown below:

Serial	Item
	TRAINING AND PREPARATION
1	Briefed on conditions and dangers; accept decision to deploy
2	Trained and organised to work whilst deployed
3	Experience of working with the military in field conditions
4	Status of Forces Agreement (SOFA) and understand Law of Armed Conflict
5	Attended field training
6	Weapons safety handling
7	Mine awareness training
8	NBC training
9	Other mandatory training prior to deployment or in-theatre
	OVERALL MEDICAL AND PERSONAL CHECK
10	Inoculations
11	Medicines/drugs (adequate supply)
12	Medically fit (medical recent, agreed by analyst)
13	Blood group
14	Particular peculiar personal risk check
	EQUIPMENT CHECK (against 'Kit List')
15	Clothing – military and/or civilian – sufficient for conditions
16	Equipment – sleeping system, webbing, bergen, etc.
17	Basic sanitary/toiletries
18	Medicines, spare spectacles
19	Documents (necessary) – ID, F Ident 108 (Geneva Convention ID card), Medical, Passport
20	Documents (desirable) – FMT600 (Service Driving Licence), Next of Kin Forms
21	Documents (questionable) – Visa
22	NBC
	IT EQUIPMENT CHECK
23	Hardware
24	Software
25	Data

B.3 EXAMPLE OF A DEPLOYMENT KIT LIST

The list below is a generic deployment kit list. A deploying analyst should verify their National Policy to ensure all relevant items are taken for a deployment.

Serial	Item	Quantity
	EQUIPMENT TO BE CARRIED IN WEBBING	
1	Water Bottle	1
2	Mug	1
3	Knife, fork, spoon	1 set
4	Mess tins	1 set
5	Insect repellent	1
6	Sun block	1
7	Individual first aid kit	1
8	Purification tablets	1
9	Spare rations	1 (if issued)
10	Torch and spare batteries	1
	EQUIPMENT TO BE CARRIED IN A BERGEN	
1	Roll mat	1
2	Sleeping system	1
3	Bivi Bag	1
4	Spare Underwear	As appropriate
5	Combat clothing	1
6	Combat jacket	1
7	Spare water bottle	1
8	Washing and shaving kit	1
9	Boot cleaning kit	1
10	Fleece (or equivalent warm clothing)	1 set
11	Green t-shirt	2
12	Combat body armour	1
13	Helmet	1
14	Respirator (and spare sealed canister)	1
15	Mosquito net	1
16	Tent Section	1
	EQUIPMENT TO BE CARRIED IN A HOLDALL	
1	Combat clothing	1 set
2	Combat high boots	1 pair

Serial	Item	Quantity
3	Washing and shaving kit	1 set
4	Towel	1
5	Swimming kit	1
6	Civilian clothing (It is advisable to take at least one set of civilian clothing in case a civilian flight is taken on the way back, or for meeting aid agencies, etc.)	As required
7	Sport kit	As required
8	Training shoes	1 pair
9	Letter writing kit	
10	Spare spectacles	As required
11	Pyjamas	Optional
	DRESS FOR MOVE	
1	Combat clothing	
2	ID card and discs	
3	Notebook and pen	
4	Passport	
5	Day sack (with overnight kit and medicines)	
6	Money	
	MAIN FORMS OF PROTECTIVE CLOTHING REQUIRED ON DEPLOYMENT	
1	Helmet (all operations)	
2	Ear defenders	
3	Flak jacket (when appropriate)	
4	Sturdy boots with ankle and toe protection (all deployments)	
5	Cold weather clothing	
6	Hot weather clothing	
7	Gloves (for either climate or sharp objects)	

B.4 EXAMPLE IT AND ASSOCIATED CONSUMABLES DEPLOYMENT IT AND STATIONERY LIST

Serial	Item	Suggested Quantity
	ADMIN FOLDERS CONTAINING ONE OF EACH OF	
1	Wallet(s) to hold a pack of CD-ROMs	4 in total
2	Small zip-up bags/pencil cases to hold other small items	4 in total
3	Scissors	4 in total

4	Stapler	4 in total
5	Hole punch	4 in total
6	Long ruler	4 in total
7	Protractor and set squares	4 in total
8	Compass	4 in total
9	Laser pointer	4 in total
10	Plastic cases to hold 1 or 2 floppy disks each; these are useful for passing things around	4 in total
11	Small plastic boxes to hold items like drawing pins and paperclips	4 in total
CONSUMABLES		
1	Floppy disks	Pack of 10
2	If a CD burner is taken, bland CD-ROMs	Pack of 5
3	Media for the backup device taken – i.e. zip disks or jazz disks	Pack of 5
4	Printer cartridges, colour and black	5 of each
5	Biros, several black, at least one red and one blue	Total of 20
6	Pencils	3
7	Pencil sharpeners	1
8	Erasers	2
9	Marker pens, red, blue, green and black	1 set
10	Highlighters	1 set
11	Drawing pins (to be kept in small box)	30 pins
12	Staples	Small box or strip
13	Sellotape	1 roll
14	Pritstick or similar glue	1
15	Bluetack	1 slab
16	Paperclips (to be kept in small box)	30 clips
17	Post-it notes	1 pad
18	A4-sized hardback notebook	2
19	Reporters notebook	4

Annex C – OVERVIEW OF OA TOOLS AND TECHNIQUES

Technique	Definitions/Description and Possible Uses	Possible Tools
Brainstorming and cognitive mapping	A group problem-solving technique, the participants freely air ideas and solutions to a problem. • Discussions with military decision-makers • Initial analysis of most problems • Risk assessments	MS Office, Visualisation tools, Decision Explorer
Causal mapping	A qualitative model of a process/system, based on a mapping of cause and effect of events. • Possible outcomes of a military action on the inhabitant's support to an operation	Decision Explorer
Data/information management	The planning, budgeting, control and exploitation of the information resources in an organisation. Often seen as synonymous with collecting and storing data for analysis or lessons learned, for instance by building databases. • Record lessons learned in-theatre • Customised data collection tool • Summaries and statistics • Tracking movement of factions or units • Election support/studies of political trends (databases of candidates, turnout and results)	MS Access, MS Share Point, Hyperwave, Windows Explorer
Data/information fusion	Combine data and information from different sources to provide a comprehensive picture of an operation. • Create situational awareness	MS Office, MS Access, GIS tools
Data mining	Extracting useful information from raw data.	dtSearch, MS Outlook, Internet search tools
Decision trees	Qualitative/quantitative mapping of decision problems. • Visualise decision problems • Explore interrelations and interdependencies between different aspects of a problem	DPL, MS Excel
Experiment design	The analytical process of developing a sound study. • Developing MOEs • Sampling • Data collection plans	Statistical package
Fault trees	A structured analysis to identify potential causes of system failure before the failures actually occur. • Risk analysis • Failure mode identification	Visualisation tools, MS Excel
Game theory	A branch of mathematical analysis developed to study decision-making in conflict situations. • Course of action analysis • Wargaming/non-war operations • Crisis response operations	

Technique	Definitions/Description and Possible Uses	Possible Tools
Influence diagrams	A decision support technique, often involves structuring and simplifying the analysis problem in a directed graph. • Risk assessments • Mission effectiveness • Course of action analysis	DPL, Genie, Visio, Precision Tree, MS Project
Multi-criteria analysis	A decision support technique, often involves structuring and simplifying the analysis problem in a linear hierarchy. • Course of action analysis • Task allocation in HQ restructuring	Expert Choice, TOPSYS, MS Excel
Optimisation	Analysis of which variables that will lead to an optimal solution. • Mission planning • Resource allocation • Redeployment planning • Course of action analysis	GAMS, Cplex, MS Excel, Matlab
Process modelling and project management	Analysis of the planning, organising, staffing, directing and controlling of a system. • Synchronisation of lines of operation • Modelling HQ processes (i.e. develop mounting plan and identify critical path)	MS Project, MS Excel, MS Outlook, Arena
Questionnaires/ surveys	A method of collecting information/data. • Mission effectiveness • Perceptions and attitudes	MS Office
Scenario analysis	Analysis with sets of qualitative/quantitative parameters describing (future) uncertainties and trends. • Course of action analysis • Study secure lines of communication in a range of situations • Risk assessments • Investigate possible futures	MS Office, CASPER
Simulation	Representing real-world problems/systems by a computer program, as a basis for analysis. • Timephase sequencing • Wargaming • Mission planning • Course of action planning • Redeployment planning	Simulate, Arena, Silk, Taylor
Spreadsheet modelling	Analysis of measures of effectiveness. • Decision trees • Force correlation calculations (using equipment scores and force ratios) • Combat assessments • Simple deployment/logistics calculations	MS Excel

Technique	Definitions/Description and Possible Uses	Possible Tools
Statistical analysis	A branch of mathematics for the collection and interpretation of quantitative data. • Simple statistics: histograms, scatter diagrams, pie charts • Multivariate statistics: polling data • Time series analysis: longitudinal studies • Regression analysis: model fitting • Analysis of measures of effectiveness	MS Excel (simple), SPSS, JUMP, Statistica
System dynamics	Analysis of system feedback loops. • Interaction between factors in complex operations • Crisis predictions • Timephase sequencing	MS Excel, Arena, Stella/iThink
Wargaming	A playable simulation/game of (aspects of a) a military operation. Could be manual (using maps) or computer assisted (using simulation models). • Pre-deployment planning • Course of action analysis • Logistics support • Outcomes of battle – loss estimates	GIS tools, Customised simulation models
Visualisation/ presentation	Putting information into meaningful pictures.	MS Office, Matlab, MS Access, GIS tools, Adobe Photoshop
Programming	Write software to support analytical activities.	Compilers: Visual Basic, Delphi

Annex D – EXAMPLES OF OA SUPPORTING DECISION-MAKING

D.1 GENERIC EXAMPLES OF OA IN SUPPORT OF MILITARY OPERATIONS

Title	D.1.1 Peace Support Operations (PSO)
Transfer to peace	Cessation of Hostilities (adherence to ceasefires, scale and extent of breaches). Location of forces (by number, ethnicity, scale of armament). De-Militarisation (rate, ethnicity).
Normalisation issues	Cooperation with UN/NATO forces. Cooperation with civil authority (smuggling, impersonation of government officials, collection of unofficial taxes, civil demonstration). Adherence to agreements, treaties, etc. Identification and clearance of minefields.
Basic life support issues	Utilities (water, electricity, gas, drainage, health): state of repair of facilities, availability and cost of utilities by area, number of customers, ethnic origin/religion/affiliation of consumers. Commodities (availability and cost of basic foodstuffs (flour, rice, cooking oil, meat, coffee), location and accessibility of shops and markets, housing, transport, communal facilities). Communications (roads (condition, safety), public transport, telephone network (land line and mobile)). Education (schools, colleges, universities: number open, student and teacher numbers (by ethnicity/religion), condition of buildings and facilities, subjects taught). Housing (quantity, location, state of repair, ownership, rental cost). Population (location, numbers, ethnic/religious groups). Farming (area under cultivation, number of farm animals, state of harvest).
Hostile action	Attacks against UN/NATO forces. Attacks against individuals/groups. Intimidation against individuals/groups. Attacks against property. (Assess all attack/intimidation cases by date, time of day, frequency, type of weapon, intensity of attack, ethnic origin of attackers/victims, affiliation of attackers/victims).
	D.1.2 Warfighting
Planning	Force ratio (friendly versus hostile) comparison (static scoring, nationality factors). Wargaming (Course Of Action (COA) comparison). Casualty estimation.
Weapon performance	Technical assessment of weapons and systems in campaign-specific environmental conditions. Weapon system performance – during campaign (quick look plus monitoring) and post campaign (detailed assessment). Accuracy (hit rate), warhead detonation, effectiveness (against target). Investigation of weapon failure (miss, failure to detonate).

Data collection and analysis	Post-campaign (Phase 4) weapon effectiveness assessment ('on ground' investigation of actual targets and weapon impact sites – to include weapon effects against target system as a whole). Data collection (sorties flown, weapon consumption, fuel consumption, targets attacked). Devising of Measures of Effectiveness (MoE) and Success Indicators (SI) at Operational Objective, Tactical Objective and Tactical Task levels. Application of MoE and SI to achieve Campaign Assessment (CA) (i.e. timely and reliable measure of progress within the campaign).

SPECIFIC EXAMPLES FOR OA IN SUPPORT OF MILITARY OPERATIONS

D.2 MEASURES OF NORMALITY

Title	**D.2.1 Assessment of the Measures of Normality**
Background	Peacekeeping operations Bosnia. An OA team deployed with ACE Rapid Reaction Corps: Dec 95 to Sep 96.
OA Action	Assess progress towards normality.
Timescale	Ongoing monitoring/analysis throughout operation.
Data Requirements	Price and availability of basic commodities (fuel, power, potable water, foodstuffs), crime rate. Violations of the Dayton Accords/co-operation with Kosovo Force (KFOR). Balance of power between warring factions. Co-operation with the Civil Administration (smuggling, impersonation of government officials, collection of unofficial taxes, civil demonstration). Schools: number (percentage) open: total, by location. Access to healthcare. Traffic flow. Demilitarisation rate. Minefield clearance (locations cleared, area cleared). Current Population by Ethnicity and Status (and location). Location/identity of displaced persons/refugees.
Decision Supported	Assessment of progress towards normality. Assessment of effectiveness of Peace Support Operations (PSO) force. Targeting aid and reconstruction effort (i.e. to co-operative communities). Monitoring violations of the Accords demonstrated, contrary to general perceptions, that it was the Bosnians not the Serbs who were responsible for most of the violations once the Accords were in place. This information was fed to the commander to ensure that pressure was brought to bear correctly and fairly, so avoiding false accusations and unjust responses. Deconfliction of troops and displaced persons/refugees.
Report Format	Regular briefings and written reports (daily, weekly, monthly).
Significant Lessons	This task is highly data intensive, requiring substantial effort from troops on the ground. Considerable information operations (IO) benefits from regular contact between troops and the local population. This work demonstrated the worth of having analysts "on the ground".

Title	**D.2.2 Measures of Normality – Crime Rate. Weapons Collection/Search Analysis. PSO. Balkans, Bosnia**
Background	Peacekeeping RHQ AFSOUTHs Balkan Analysis Team in support of NATO operations in the Balkans provided a statistical analysis capability to examine incidents occurring within the area of responsibility (AOR) to include crime and ethnic unrest.
OA Action	Define and measure indicators of normality, specifically crime rate. Identification of data necessary to monitor normality trends, co-ordination of data collection and data analysis. Identify any crime, tension or unrest trends. Collection and compilation/analysis of weapons searches/finds.
Timescale	Ongoing throughout operation. Initial requirement for input within short time line resulting in appropriately cavaeted response. Method of analysis subsequently developed to allow appropriate input within the Commanders decision cycle.
Data Requirements	Violations of General Framework Agreement for Peace (GFAP). Crime and Murder Rates. Violation of Dayton Accords. Balance of power between warring factions. Rate of occurrence of serious crimes (defined as murder, arson, rape, intimidation, armed attack). Ethnic origin of perpetrator and of victim. Location and time/date of crime. The acquisition and quality control of data in support of a question of this nature is a significant part of the project. Analysts are likely to be dependant on third party supplying information such as the military police or an international people body. A possible enabling task in support of this project could be the provision of a database to a third party to facilitate efficient data collection**.** Possession of weapons by type, location, ethnicity, individual/group holding.
Decision Supported	Scale and Direction of Corrective Action (Serb or Bosnian). Normality monitoring. Placements of assets to ensure best response to unrest. Revising force concepts and composition to counter criminal/racist activity to putting in place crime prevention measures.
Report Format	Briefings to Command Group, input to Six Monthly Review. Written papers. Large and detailed database of activity within the Area of Operations (AO) that supplements the long-term historical record and supports future assessments of correlating conditions, actions and results.
Significant Lessons	Value of deployed analyst to manage data collection. Value of long term data collection strategy. Reliance on military/Non-Government Organisations (NGO) to collect data in post-conflict environment. Necessity of long term data collection using standard data sets and definitions. Data requirements for this type of work differ significant from traditional OA tasks. Method applied, in overview, and results presented require to be transparent.

D.3 MEASURES OF CAMPAIGN SUCCESS/PROGRESS

Title	D.3.1 Measures of Progress/Success. Peace Support Operations. Afghanistan
Background	International Security Afghanistan Force (ISAF) I (Kabul) Feb 2001 – July 2001. 3 (UK) Div acting in a LCC role for ISAF I. Peace Support Operation involving a multinational coalition. Area of responsibility limited to Kabul only, a large flat expanse of land at high altitude surrounded by mountainous terrain.
OA Action	OA was used to collect and analyse data in order to review and evaluate the overall success of the campaign plan.
Timescale	This study was conducted through out the deployment of ISAF I. Initially the data was gathered by the Brigade HQ and was subsequently handed over to the OA team in theatre. A summary report was produced on weekly basis.
Data Requirements	Crime statistics. Patrol reports, Intelligence Summaries, questionnaires, Medical Reports, flight schedules, etc.
Decision Supported	The results were presented to visiting, politicians, VIPs and the press in order to demonstrate the positive effect ISAF I was having on Kabul and the local community. In addition it was used to put pressure on the Interim Authority to take action in areas and against individuals who were not complying with the military technical agreement.
Report Format	A weekly Situational Report, PowerPoint presentation and statistical report.
Significant Lessons	Improved doctrine for conduction a MOE Study and earlier inclusion in the campaign planning and subsequent deployment. (N.B. MOE study was not continued by ISAF II).
References	All documents held at HQ LAND, OA.

D.4 RISK ASSESSMENT

Title.	D.4.1 Security Measures
Background	Peacekeeping ISAF had security concerns about the admission process for delegates to the 2002 Loya Jirga in Kabul. In particular, the task of processing the large number of delegates expected was significant, and there was concern that insufficient attention was being paid to the problem.
OA Action	A model of the admission process was generated to illustrate delays in getting delegates in.
Timescale	Short term, one off action.
Data Requirements	Likely attendance, rate of arrival, search procedures.
Decision Supported	Analysis proved that the proposed search/security resources were insufficient for efficient processing of delegates in timely manner. Resources allocated to LJ security were substantially increased (with successful results).
Report Format	Results were briefed to ISAF Commanders in time to influence the LJ planning process.
Significant Lessons	OA is applicable to short term, unique problems, and can provide insight and quantification that purely subjective analysis would not produce. Value of a quick simulation tool for visualisation and briefing.

Title	D.4.2 Risk from Rebel Force Attack. Peace Support Operation/Warfighting. Sierra Leone
Background	Permanent Joint HQ J5 OA reports were generated for Assistant Chief Of Staff (ACOS) J3 to support the Non-combatant Evacuation Operation (NEO) being conducted from Sierra Leone. This was a NEO, Joint medium scale.
OA Action	OA was used to help assess the risks to British Forces had the rebels attacked the airfield at Lunghi. The OA was instrumental in persuading Ministers and senior military staffs of the need to disembark the Marines artillery from HMS Ocean to the airfield. The OA demonstrated the reduction in own casualties by having artillery on call.
Timescale	The work was proactive and took less than half a day.
Data Requirements	The model required friendly and enemy orders of battles, weapon and equipment performance tables, etc.
Decision Supported	This was a piece of proactive OA, which was grabbed by the ACOS to support the case for disembarkation of the Commando artillery.
Report Format	A two page report using the headings, Question, Assumptions, Results and a Casualty graph.
Significant Lessons	Need to work closely with the ACOS and his staff and be proactive when questions are not being asked.

D.5 CONTINGENCY PLANNING

Title	D.5.1 Withdrawal of Forces. Peace Support Operations (PSO)/Warfighting. Bosnia
Background	OA reports were generated for HQ Land to support the UK planning for contingency operations in Bosnia. This was primarily concerned with withdrawal operations, possibly warfighting at land/air, medium scale. Policy military gaming work was also conducted for HQ UNPROFOR with regard to the newly formed rapid reaction force.
OA Action	OA was used to assess the risks associated with both UK and UN plans for the withdrawal of forces from Bosnia under a range of different conditions. Alternative Courses of action (COAs) were examined and compared in terms of probability of success, duration, personnel and equipment casualties caused and identified risks.
Timescale	Long term, ongoing, review of contingency plans, amendment of contingency plans. The gaming and analysis work took place from 93-95, over a number of years several weeks at a time using military players. The work items were completed to time to inform both UK and multinational meetings.
Data Requirements	Enemy and friendly ORBATS, weapon and equipment performance data for a number of different wargames and other analysis tools.
Decision Supported	The work was generally concerned with identifying and quantifying risks and making enhancements to contingency plans. Changes were made to plans as a result of the work.
Report Format	Generally in the form of a PowerPoint presentation report.
Significant Lessons	Need for a faster wargame at all levels.

Title	D.5.2 Warfighting. Kosovo
Background	Permanent Joint HQ (PJHQ) J5 OA reports were generated for Chief of Joint Operations (CJO) and the Assistant Chief of Staff (ACOS) J3 to support the UK planning for possible Land operations in Kosovo. This was war-fighting at Joint, medium scale. MNB(C) contingency planning for possible Land operations in northern Kosovo (Podujevo). This was a multinational (NATO) war-fighting scenario at Brigade level. The scenario was centred on the Podujevo bowl, a large flat expanse of land at high altitude surrounded by mountainous terrain. The CONPLAN assumed that adverse weather conditions would prevent any air support for up to five days.
OA Action	OA was used to assess the risks of a forced entry into Kosovo. Military staff from the HQ (G3, G2, Artillery) conducted the wargame and a team of two OA analysts adjudicated, analysed and then presented the results. Alternative courses of action (COA) were examined and compared in terms of force ratios, probability of success, duration, personnel and equipment casualties caused and identified risks. Another particular question asked concerned the amount of artillery ammunition required. This was required by the UK Chiefs of Staff (COS) who was debating an order for a buy of artillery ammunition.
Timescale	The gaming was conducted in theatre over a period of two weeks. One week was required to set up the model and collate the required data and one week to game the concept of plans (CONPLAN) and its subsequent iterations.
Data Requirements	Enemy and friendly orders of battle, weapon and equipment performance data for the wargame and other analysis tools.
Decision Supported	The wargame identified fundamental flaws in the existing concept of plans highlighting friendly forces susceptibility to enemy artillery fire. The wargaming predicted an unacceptably high level of friendly casualties prompting the Commander to request that the concept of plans was completely reworked. A number of new COAs were then developed and subsequently wargamed in order to optimise a revised CONPLAN.
Report Format	A PowerPoint presentation report.
Significant Lessons	Need for a faster wargame. This process was initially completed for 19 Mechanised Brigade, but was subsequently repeated with 7 Armoured Brigade when they took over command. The concept of plans was once again wargamed and refined to take into account the differing force structure and tactics employed by an Armoured Brigade in comparison to a Mechanised Brigade.

Title	D.5.3 Prisoners of War. Warfighting. Gulf War 2 (03)
Background	Prior to the invasion of Iraq in 2003 there was concern that, based on experience in the 1991 Gulf War, potentially very large numbers of Iraqi troops would surrender, and that the number of enemy prisoners of war (PoW) could saturate the ability of the Coalition to process and look after them in accordance with the Laws of Armed Conflict.
OA Action	Estimates were made of the likely and worst case enemy prisoners of war numbers, based on expected combat and experience of the 1991 Gulf War. The number of troops required for escort and guard duties was estimated.
Timescale	Medium term contingency planning.
Data Requirements	Hostile forces by number and unit (i.e. difference between regular army, Republican Guard, Special Republican Guard in terms of willingness to fight).

Decision Supported	The OA informed decisions on numbers of troops required for this task, their training, and the likely consequences of very large numbers of enemy prisoners of war on security.
Report Format	A written summary was produced of the initial work, followed by several written clarifications.
Significant Lessons	It is essential to point out to the "customer" the way the answer can vary with the assumptions, many of which are not within our control. In particular, there was uncertainty about whether soldiers would actually insist on their rights under the LOAC to be taken prisoner (and hence looked after and protected by their captors), or whether the majority would simply discard their uniforms and go home. Guarding level requirements with respect to whether enemy prisoners of war were captured or surrendered willingly.

D.6 COURSE OF ACTION ASSESSMENT

Title	**D.6.1 Implications of Use of Scarce Weapons**
Background	Support to Combined Air Operations Center at 5ATAF, Vicenza, Italy.
OA Action	Evaluate the implications of deploying strike aircraft to theatre on the consumption of scarce laser guided munitions. Analysis was based on historical and forecasted usage.
Timescale	3 days.
Data Requirements	Data came from many sources, primarily mission reports. This effort depended on reachback to Ramstein OAT.
Decision Supported	Based on this analysis the decision was made to augment the supply of munitions augmented by moving pre-positioned stocks.
Report Format	Briefed to Combined Forces Air Component Commander.
Significant Lessons	Analysts need to have data awareness and accessibility.
References	MORS PHALANX and USAF Air War over Serbia Archive.

Title	**D.6.2 Urban Close Air Support. Warfighting. Gulf War 2 (03)**
Background	Support to Coalition ground forces in potential urban operations – utility of air power. Urban close air support (UCAS).
OA Action	Investigation of utility of different air launched weapon systems in the UCAS role.
Timescale	For medium term planning (time expended 6 hours).
Data Requirements	Capability/performance of air launched weapon systems (accuracy, destructive effect, mode of delivery/terminal profile).
Decision Supported	Implications of use of air power in UCAS role.
Report Format	Written report (one side A4).
Significant Lessons	Value of analytical approach to decision support; compilation of data strands, synthesis of different data to form overall conclusion.

D.7 MEASURING ENEMY CAPABILITY

Title	D.7.1 Force Ratio Comparison. Warfighting. Gulf War 1 (91)
Background	Land/air war, multinational coalition, conducted at divisional level.
OA Action	Developed div level plan identifying enemy elements that each brigade would defeat for only 10% friendly casualties. Other work concerned contingency planning and risk analysis, in-theatre trials and data collection.
Timescale	Ongoing task over medium term (6 weeks) with individual outputs in short term (every 2 to 3 days).
Data Requirements	Friendly and enemy orders of battle (ORBATS), weapon and equipment performance tables, etc. Specialist data was called for by reachback: relative combat power of Blue and Red systems, weapons, ranges. Nationality factors.
Decision Supported	Commander used OA to help develop and quantify his plans and ended up providing the norms and guidelines for the plans officer during the conflict.
Report Format	A series of two/three page reports using the headings, Question, Assumptions, Results and a diagram or graph.
Significant Lessons	Need to work closely with the Commander and his plans staff (use of common database). Analysts need to be flexible in approach and be prepared to assimilate new information in timely manner.

Title	D.7.2 Enemy Force Analysis – Integrated Air Defense System. Warfighting. Gulf War 1 (91), Kosovo (99), Gulf War 2 (03)
Background	Suppression of enemy air defences (SEAD): analysis of enemy air defences capability.
OA Action	Advice was required on the apportionment of air effort to degrade the enemy integrated air defence system (IADS) and to monitor progress of that degradation in an objective and quantified way. The capability of the IADS was modelled to assess its effectiveness, and how this varied through the air campaign.
Timescale	Ongoing, daily assessment.
Data Requirements	Enemy IADS order of battle (ORBAT): e.g. number and location of early warning radar, radar transmissions, number and location of strategic surface-to-air missiles (SAM).
Decision Supported	Proportion of Coalition air effort to SEAD.
Report Format	By means of a daily briefing to the Air Component Commander, usually in graphical form.
Significant Lessons	In reporting, the relative change in IADS capability score is more important than the raw score itself. Consistency of data collection, analysis and summation is important for continuity.

D.8 MISSION EVALUATION

Title	D.8.1 The Focus of HQ ISAF III. PSO
Background	Evaluation of the mission of HQ ISAF III in Kabul, Afghanistan, GE/NL led Peace support operations.

OA Action	Evaluate whether the focus of the staff was correct in relation to the mission of HQ ISAF III. Translate the efforts on task level to the effect on mission level. Based on this analysis, the OA cell wrote recommendations for other, comparable, future missions.
Timescale	3-month deployment of two analysts, assignment finished in this time frame.
Data Requirements	Because of the short timescale, there was not much room for specific data collection. The results of a survey held among the Kabul People, for which the OA cell did the organisation and the data analysis, were used. Main sources of data were the interviews with task owners and other members of the staff and using this (subjective) data.
Decision Supported	The OA supported the decision about the overall value of the mission. To what extent could the Senior National Officer state that the mission was a success?
Report Format	The results were presented in a written document.
Significant Lessons	Analysts need to be outgoing, especially in developing the relations with task owners and other members of the staff (Mainly Assistant Chief of Staff level). There was a relation with lessons learned. LL looked at whether the task was done correctly, while OA looked at whether the correct tasks were emphasized or done.

D.9 TECHNICAL ISSUES

Title	**D.9.1 Disruptive Pattern Schemes for Mine Counter Measure Vehicles (MCMV). Maritime Warfare Centre (MWC), UK Task**
Background	Maritime/Littoral, Warfighting: Medium, Multinational-coalition, Arabian Gulf. Mine Counter-Measure Vessels (MCMVs) were deployed into the Iraqi littoral for MCM and patrol operations and faced the threat of attack from land forces. The CTG was concerned about the ships being opportunity targets for visually aimed weapons.
OA Action	MWC was requested to provide advice on a disruptive pattern scheme for UK MCMVs optimised against visual detection at short range.
Timescale	The requirement was to provide advice as soon as possible. In fact, a report was made less than 3 weeks after the task was raised, this period included the traditional Christmas holiday. The advice supplied was adequate for the Commander Task Group's needs.
Data Requirements	The information required included open source photographs of the coastline to determine the predominant colours of sea, land and sky, together with climatology to ascertain the prevalence of atmospheric degradation such as fog. Visual detection data on colours, size and shape were also used.
Decision Supported	The OA advice was not to implement a disruptive pattern scheme as this would increase visual detectability. This recommendation was accepted. Recommendations were also made for visual signature reduction methods such as 'counter-shading' involving brightening dark areas and darkening visual highlights, and the use of camouflage netting to mask the outline of the vessels. This advice was adopted.
Report Format	Letter report.
Significant Lessons	The work drew on a mixture of scientific and engineering expertise at the MWC.

Title	D.9.2 Sensor Performance and Ship Susceptibility. Maritime Warfare Centre (MWC), UK Task
Background	Maritime Peace Support Operation, multinational-coalition (not NATO, although working alongside units under NATO command) in the Adriatic conducting surveillance operations on units that could pose a threat to UK land forces deployed on peacekeeping operations.
OA Action	The tasking was to conduct predictive analysis in support of the deployed Royal Navy Task Group. Shipborne and airborne sensor performance in the Above Water Warfare (AWW) and Under Water Warfare environments was predicted and the susceptibility of the TG to attack was determined. Mine Counter Measures (MCM) tasking considered the likely mine threat and associated risks in the likely choke points. In addition, a study was made of the self-defence capabilities of unarmed units such as Ships Taken Up From Trade (STUFT) and or lightly armed auxiliary vessels.
Timescale	The output was a series of reports spread over the months. The required response time varied from days to weeks dependent on the subject. The permitted timescale was always reflected in the depth of analysis. Owing to the elapsed time, it is not possible to reassess the limitations of output and the potentially better product had more time been available.
Data Requirements	Information required was on own ship systems and on potential threat systems. Although some specific detail may have been missing, overall the information was adequate.
Decision Supported	The frequent lack of formal feedback increases the difficulty of answering this question. Usually in such cases the overall concept of operation of naval TGs is unaltered, but the OA work provides a better-informed assessment of risk and this might persuade the Commander Task Group to modify parts of the operating pattern.
Report Format	The reports were delivered in written format. When speed was essential, highlights would be transmitted by signal message.
Significant Lessons	These studies enhanced the capability of the MWC to support deployed commanders. In addition they encouraged staff officers to request OA support for their decision-making.

REPORT DOCUMENTATION PAGE

1. Recipient's Reference	2. Originator's References	3. Further Reference	4. Security Classification of Document
	RTO-TR-SAS-044 AC/323(SAS-044)TP/46	ISBN 92-837-1131-9	UNCLASSIFIED/ UNLIMITED

5. Originator

Research and Technology Organisation
North Atlantic Treaty Organisation
BP 25, F-92201 Neuilly-sur-Seine Cedex, France

6. Title

Decision Support to Combined Joint Task Force and Component Commanders

7. Presented at/Sponsored by

The RTO Studies, Analysis and Simulation Panel (SAS).

8. Author(s)/Editor(s)	9. Date
Multiple	December 2004
10. Author's/Editor's Address	**11. Pages**
Multiple	80

12. Distribution Statement

There are no restrictions on the distribution of this document. Information about the availability of this and other RTO unclassified publications is given on the back cover.

13. Keywords/Descriptors

Command and control
Data fusion
Decision making
Force structure planning
Information systems
Joint operations
Mission effectiveness
Mission profiles
Multilateral forces
Operational effectiveness
Personnel selection
Resource management
Scenarios

14. Abstract

The aim of NATO Technical Team SAS 044 'Decision Support to Combined Joint Task Force and Component Commanders' has been to establish the current status of analysis in direct support of Commanders within NATO, and Nations. It has concentrated on the general principles for successful analytical support, rather than identification of specific tools and models.

The guidance in this Code is intended to assist analysts and military staff in understanding the principles of providing decision support to Commanders. It is not intended to be prescriptive, nor exhaustive, and is based upon knowledge from experience gained on recent operations. This Code contains pertinent information aimed at helping prepare, deploy, integrate and support OA teams in the field. In addition to the COBP, the team has developed a short summary document (two pages in length), explaining the role of operational analysis in a form more accessible to those working under short time scales, such as senior military commanders. This summary document is an Annex in the Code.

NORTH ATLANTIC TREATY ORGANISATION

RESEARCH AND TECHNOLOGY ORGANISATION

BP 25
F-92201 NEUILLY-SUR-SEINE CEDEX • FRANCE
Télécopie 0(1)55.61.22.99 • E-mail mailbox@rta.nato.int

DIFFUSION DES PUBLICATIONS

RTO NON CLASSIFIEES

Les publications de l'AGARD et de la RTO peuvent parfois être obtenues auprès des centres nationaux de distribution indiqués ci-dessous. Si vous souhaitez recevoir toutes les publications de la RTO, ou simplement celles qui concernent certains Panels, vous pouvez demander d'être inclus soit à titre personnel, soit au nom de votre organisation, sur la liste d'envoi.

Les publications de la RTO et de l'AGARD sont également en vente auprès des agences de vente indiquées ci-dessous.

Les demandes de documents RTO ou AGARD doivent comporter la dénomination « RTO » ou « AGARD » selon le cas, suivi du numéro de série. Des informations analogues, telles que le titre est la date de publication sont souhaitables.

Si vous souhaitez recevoir une notification électronique de la disponibilité des rapports de la RTO au fur et à mesure de leur publication, vous pouvez consulter notre site Web (www.rta.nato.int) et vous abonner à ce service.

CENTRES DE DIFFUSION NATIONAUX

ALLEMAGNE
Streitkräfteamt / Abteilung III
Fachinformationszentrum der
Bundeswehr (FIZBw)
Friedrich-Ebert-Allee 34, D-53113 Bonn

BELGIQUE
Etat-Major de la Défense
Département d'Etat-Major Stratégie
ACOS-STRAT – Coord. RTO
Quartier Reine Elisabeth
Rue d'Evère, B-1140 Bruxelles

CANADA
DSIGRD2
Bibliothécaire des ressources du savoir
R et D pour la défense Canada
Ministère de la Défense nationale
305, rue Rideau, 9e étage
Ottawa, Ontario K1A 0K2

DANEMARK
Danish Defence Research Establishment
Ryvangs Allé 1, P.O. Box 2715
DK-2100 Copenhagen Ø

ESPAGNE
SDG TECEN / DGAM
C/ Arturo Soria 289
Madrid 28033

ETATS-UNIS
NASA Center for AeroSpace
Information (CASI)
Parkway Center, 7121 Standard Drive
Hanover, MD 21076-1320

FRANCE
O.N.E.R.A. (ISP)
29, Avenue de la Division Leclerc
BP 72, 92322 Châtillon Cedex

GRECE (Correspondant)
Defence Industry & Research
General Directorate, Research Directorate
Fakinos Base Camp, S.T.G. 1020
Holargos, Athens

HONGRIE
Department for Scientific Analysis
Institute of Military Technology
Ministry of Defence
H-1525 Budapest P O Box 26

ISLANDE
Director of Aviation
c/o Flugrad
Reykjavik

ITALIE
Centro di Documentazione
Tecnico-Scientifica della Difesa
Via XX Settembre 123
00187 Roma

LUXEMBOURG
Voir Belgique

NORVEGE
Norwegian Defence Research Establishment
Attn: Biblioteket
P.O. Box 25, NO-2007 Kjeller

PAYS-BAS
Royal Netherlands Military
Academy Library
P.O. Box 90.002
4800 PA Breda

POLOGNE
Armament Policy Department
218 Niepodleglosci Av.
00-911 Warsaw

PORTUGAL
Estado Maior da Força Aérea
SDFA – Centro de Documentação
Alfragide
P-2720 Amadora

REPUBLIQUE TCHEQUE
LOM PRAHA s.p.
VTÚL a PVO o.z.
DIS ČR – NATO RTO
Tiskařská 8
100 38 Praha 10

ROYAUME-UNI
Dstl Knowledge Services
Information Centre, Building 247
Dstl Porton Down
Salisbury
Wiltshire SP4 0JQ

TURQUIE
Milli Savunma Bakanlığı (MSB)
ARGE ve Teknoloji Dairesi Başkanlığı
06650 Bakanliklar – Ankara

AGENCES DE VENTE

NASA Center for AeroSpace Information (CASI)
Parkway Center, 7121 Standard Drive
Hanover, MD 21076-1320
ETATS-UNIS

The British Library Document Supply Centre
Boston Spa, Wetherby
West Yorkshire LS23 7BQ
ROYAUME-UNI

Canada Institute for Scientific and Technical Information (CISTI)
National Research Council
Acquisitions, Montreal Road, Building M-55
Ottawa K1A 0S2, CANADA

Les demandes de documents RTO ou AGARD doivent comporter la dénomination « RTO » ou « AGARD » selon le cas, suivie du numéro de série (par exemple AGARD-AG-315). Des informations analogues, telles que le titre et la date de publication sont souhaitables. Des références bibliographiques complètes ainsi que des résumés des publications RTO et AGARD figurent dans les journaux suivants :

Scientific and Technical Aerospace Reports (STAR)
STAR peut être consulté en ligne au localisateur de ressources uniformes (URL) suivant:
http://www.sti.nasa.gov/Pubs/star/Star.html
STAR est édité par CASI dans le cadre du programme NASA d'information scientifique et technique (STI)
STI Program Office, MS 157A
NASA Langley Research Center
Hampton, Virginia 23681-0001
ETATS-UNIS

Government Reports Announcements & Index (GRA&I)
publié par le National Technical Information Service
Springfield
Virginia 2216
ETATS-UNIS
(accessible également en mode interactif dans la base de données bibliographiques en ligne du NTIS, et sur CD-ROM)

NORTH ATLANTIC TREATY ORGANISATION

RESEARCH AND TECHNOLOGY ORGANISATION

BP 25
F-92201 NEUILLY-SUR-SEINE CEDEX • FRANCE
Télécopie 0(1)55.61.22.99 • E-mail mailbox@rta.nato.int

DISTRIBUTION OF UNCLASSIFIED RTO PUBLICATIONS

AGARD & RTO publications are sometimes available from the National Distribution Centres listed below. If you wish to receive all RTO reports, or just those relating to one or more specific RTO Panels, they may be willing to include you (or your Organisation) in their distribution.

RTO and AGARD reports may also be purchased from the Sales Agencies listed below.

Requests for RTO or AGARD documents should include the word 'RTO' or 'AGARD', as appropriate, followed by the serial number. Collateral information such as title and publication date is desirable.

If you wish to receive electronic notification of RTO reports as they are published, please visit our website (www.rta.nato.int) from where you can register for this service.

NATIONAL DISTRIBUTION CENTRES

BELGIUM
Etat-Major de la Défense
Département d'Etat-Major Stratégie
ACOS-STRAT – Coord. RTO
Quartier Reine Elisabeth
Rue d'Evère
B-1140 Bruxelles

CANADA
DRDKIM2
Knowledge Resources Librarian
Defence R&D Canada
Department of National Defence
305 Rideau Street
9th Floor
Ottawa, Ontario K1A 0K2

CZECH REPUBLIC
LOM PRAHA s.p.
VTÚL a PVO o.z.
DIS ČR – NATO RTO
Tiskařská 8
100 38 Praha 10

DENMARK
Danish Defence Research Establishment
Ryvangs Allé 1
P.O. Box 2715
DK-2100 Copenhagen Ø

FRANCE
O.N.E.R.A. (ISP)
29, Avenue de la Division Leclerc
BP 72
92322 Châtillon Cedex

GERMANY
Streitkräfteamt / Abteilung III
Fachinformationszentrum der Bundeswehr (FIZBw)
Friedrich-Ebert-Allee 34
D-53113 Bonn

GREECE (Point of Contact)
Defence Industry & Research General Directorate, Research Directorate
Fakinos Base Camp, S.T.G. 1020
Holargos, Athens

HUNGARY
Department for Scientific Analysis
Institute of Military Technology
Ministry of Defence
H-1525 Budapest P O Box 26

ICELAND
Director of Aviation
c/o Flugrad, Reykjavik

ITALY
Centro di Documentazione Tecnico-Scientifica della Difesa
Via XX Settembre 123
00187 Roma

LUXEMBOURG
See Belgium

NETHERLANDS
Royal Netherlands Military Academy Library
P.O. Box 90.002
4800 PA Breda

NORWAY
Norwegian Defence Research Establishment
Attn: Biblioteket
P.O. Box 25, NO-2007 Kjeller

POLAND
Armament Policy Department
218 Niepodleglosci Av.
00-911 Warsaw

PORTUGAL
Estado Maior da Força Aérea
SDFA – Centro de Documentação
Alfragide, P-2720 Amadora

SPAIN
SDG TECEN / DGAM
C/ Arturo Soria 289
Madrid 28033

TURKEY
Milli Savunma Bakanlığı (MSB)
ARGE ve Teknoloji Dairesi Başkanlığı
06650 Bakanliklar – Ankara

UNITED KINGDOM
Dstl Knowledge Services
Information Centre, Building 247
Dstl Porton Down
Salisbury, Wiltshire SP4 0JQ

UNITED STATES
NASA Center for AeroSpace Information (CASI)
Parkway Center, 7121 Standard Drive
Hanover, MD 21076-1320

SALES AGENCIES

NASA Center for AeroSpace Information (CASI)
Parkway Center
7121 Standard Drive
Hanover, MD 21076-1320
UNITED STATES

The British Library Document Supply Centre
Boston Spa, Wetherby
West Yorkshire LS23 7BQ
UNITED KINGDOM

Canada Institute for Scientific and Technical Information (CISTI)
National Research Council
Acquisitions
Montreal Road, Building M-55
Ottawa K1A 0S2, CANADA

Requests for RTO or AGARD documents should include the word 'RTO' or 'AGARD', as appropriate, followed by the serial number (for example AGARD-AG-315). Collateral information such as title and publication date is desirable. Full bibliographical references and abstracts of RTO and AGARD publications are given in the following journals:

Scientific and Technical Aerospace Reports (STAR)
STAR is available on-line at the following uniform resource locator:
http://www.sti.nasa.gov/Pubs/star/Star.html
STAR is published by CASI for the NASA Scientific and Technical Information (STI) Program
STI Program Office, MS 157A
NASA Langley Research Center
Hampton, Virginia 23681-0001
UNITED STATES

Government Reports Announcements & Index (GRA&I)
published by the National Technical Information Service
Springfield
Virginia 2216
UNITED STATES
(also available online in the NTIS Bibliographic Database or on CD-ROM)

ISBN 92-837-1131-9